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MICROCOMPUTING™

MICROCOMPUTERS IN EDUCATION

Will Johnnie And Suzie Compute?
Special Supplement: Computers in Schools — programs, profiles, prognostications. P. 99

Kilobaud Klassroom Returns!
For you die-hards. Here's KK No. 19. P. 22

Keep Cool By Computer
BASIC air-conditioning program. P. 48

Look at a "New" Language
An intro to Pascal. P. 68

Friendly Skies
Keep them that way with "UFO Defense." P. 210

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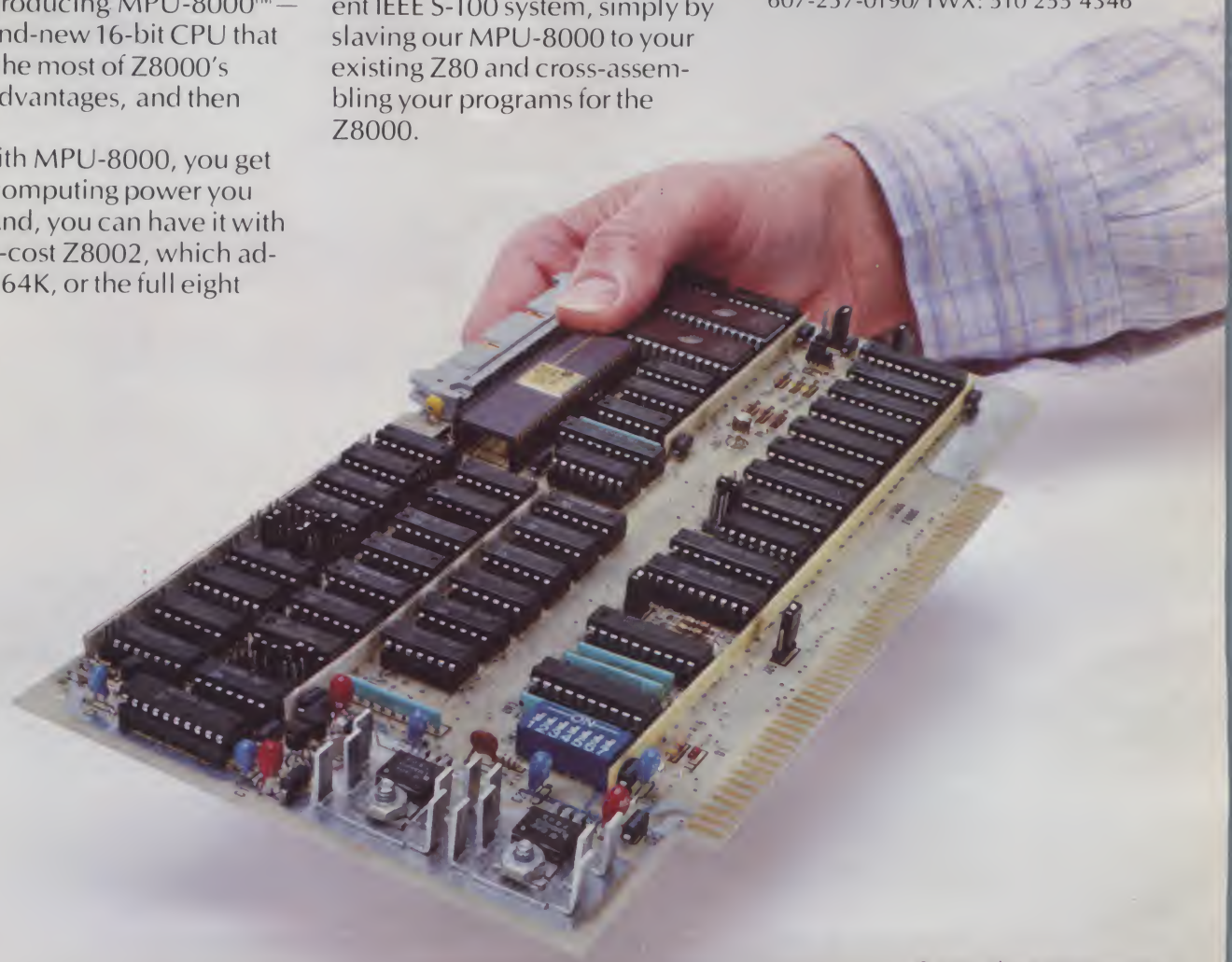
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$ This symbol next to a title in the table of contents indicates that the article is a business-application article.

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Wayne Green

PUBLISHER'S REMARKS

Education Issue

As I've written before, I expect to see microcomputers assume an important role in American education. With that thought in mind, *Microcomputing* has put together a special section on microcomputers in education. There are programs for use by educators, projections on the use of microcomputers in educational environments, information on how to use your computer education to get a job and articles of general interest to everyone—professionals, laymen, students and parents.

This section starts on page 99. I'll stop here and let you get right to it.



Photo 4.

A Visit to Commodore

While in the San Francisco area for the Faire, I made an excursion to nearby Silicon Valley to visit Commodore, Apple, Atari and Hewlett-Packard. In a way I'm glad I don't live anywhere near there because there are too many interesting people to talk with and too many exciting firms to visit. It would be a full-time career just to keep on top of it.

It has been two years since I last visited the Commodore people, so I wanted to see their growth and talk about their plans. They have two new systems in the works which should give the competition fits. The firm has moved to a new, solar-heated building and has an impressive production-line assembly going strong.

Photo 1 shows where the subassemblies are put together and where the beginnings of a roller-type assembly line are started. Photo 2 shows where the boards are packed with parts before they go into the wave soldering system and are made ready for the final assembly.

Piece by piece, the systems are assembled as they move along the line (Photo 3). Here the cabinet is put onto the unit, and it goes to an area for testing and adjustment. From there, the units move to the burn-in racks (Photo 4), where every system is run for 24 hours, the time during which most early failures take place.

After burn-in, the systems are given a last check and adjustment, and then passed through on the rollers to a shipping department (Photo 5). The volume of systems made each day is large. If several truckloads a day didn't go out, the plant would quickly fill up.

The software-development department wasn't too active, but perhaps I visited during a coffee break. Outside firms are developing most of the software for the system, so maybe this scene was normal.

No visit to Commodore is complete without a trip to the roof to see the solar-heating system (Photo 6), which heats and cools the plant.

The plant was impressive; the people were enthusiastic and cooperative. I believe that



Photo 2.



Photo 1.



Photo 3.

Commodore is concentrating on sales in Europe these days, which explains the marketing mix I see in the computer stores around the U.S., and the availability of the PET even in department stores in Europe.

A Visit to Hewlett-Packard

During my recent visit to the San Francisco area, I was invited to talk at the Hewlett-Packard ham club, where I saw a demonstration of HP's new plotter. It's going to be a while before these are available for microcomputer systems. The four-color welcome in Fig. 1 was produced entirely on the HP plotter. The plotter takes a long time to do the work, but it patiently deposits the pen it has been using in a holder and then grabs another to change colors. An algorithm guides the pen to draw each letter. Someone spent a lot of time working on the plotting program for the HP alphabets.

I suppose it would be unusual for a ham club located in the heart of Silicon Valley not to be computer oriented. In addressing the club, I tried to put the situation with consumer computers into perspective. Like most other computerists, many club members had been looking at the world through their own rose-colored glasses, seeing vast numbers of their own computers and turning a blind eye to all the others.

This myopia is OK unless you try to make money from computers. Then a more realistic appraisal of the situation is important. You have to deal with the incredible number of TRS-80 systems, which present the largest market, by far, for software and add-ons. I discussed the future of the microcomputer market as I see it, and the prospects for making big money through programming or the development of a product for the market. I further suggested some products, not yet available, that I think are necessary and can be successful in this market.

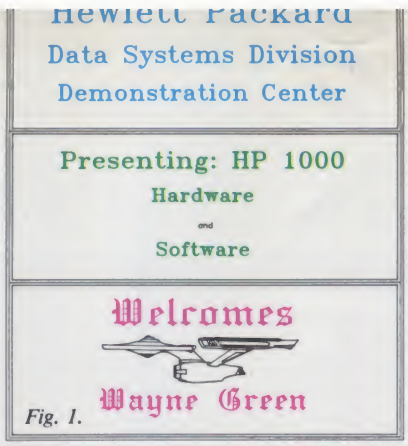


Fig. 1.

I made a tape of my computer/ham talk, which might interest some computer/ham clubs. It runs about 1:45 on two one-hour cassettes. Copies are available for masochists or clubs with little to do during a meeting: $10 for the two cassettes—easily worth half that. Write for Wayne's Cupertino Talk, and send money c/o this magazine.

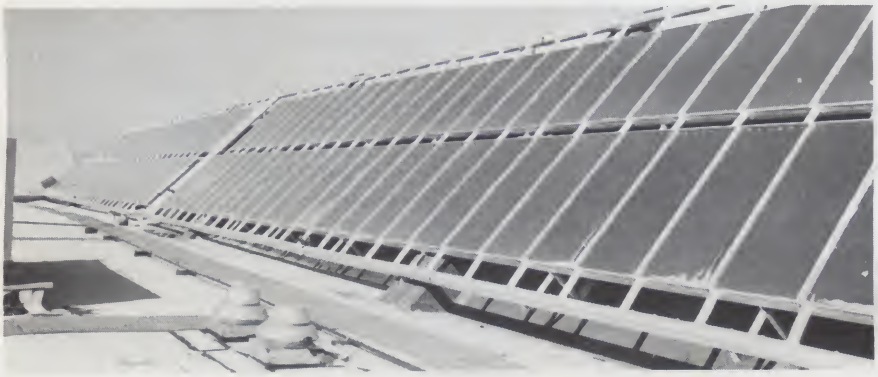

Photo 5.

Better Subscribe—Now

Effective with the July issue, the cover price and subscription rate for *Microcomputing* will increase to $2.95 per copy and $25 per year (U.S.). This reflects the size increase of the magazine, which uses more paper and raises the postage costs, as well as inflationary trends.

You can save if you extend your subscription for three years at the current rate of $45 in the U.S. See page 5 for foreign rates. That means a saving of at least $30 over the next three years.

Inflation shows no sign of flagging, so we may see yet another subscription increase next year . . . and the year after. Take advantage of our current low rates now.


Photo 6.

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OUTPUT FROM ISI

How About Atari?

The Atari people are placing their systems in stores all around the country, and delivering hardware. I expect a rising demand for Atari software. I suggest that programmers write software for the Atari 800, and contact Instant Software if they are in a position to convert programs written for other systems for use on the Atari. Instant Software wants to publish at least a couple hundred good programs—game, scientific, education and business—for the Atari system before the end of this year.

ISI royalties are 20 percent of the gross income derived from the sale of the programs, and ISI has good program distribution: reps contact all computer stores.

In keeping with the theme of this month's issue, "microcomputers in education," I should mention that ISI produces the following educational programs. More are in the works.

Program	System	Program number	Price
Grade Book	TRS-80 Level I & II	0050R	$7.95
Teacher	TRS-80 Level II	0065R	$9.95
Wordwatch	TRS-80 Level II	0111R	$7.95
Math Tutor I	Apple Cassette	0073A	$7.95
Math Tutor II	Apple Cassette	0098A	$7.95
Math Fun (Math Tutor I and Math Tutor II)	Apple Disk	0163	$24.95
Typing Teacher	TRS-80 Level I & II	0099R	$7.95
Video Speed-Reading Trainer	TRS-80 Level II	0100R	$7.95
Geography Explorer	TRS-80 Disk	0071R	$49.95

Robert W. Baker

PET-POURRI

Thanks to the excellent support from Commodore, I'm now fully equipped to test and review almost any software or hardware accessory for the PET. I have both 8K and 32K PETs, two cassette drives, a 2040 disk, a 2023 printer and an Axiom EX-801 printer. I also have a BASIC Switch from Small Systems Services, but I'm still waiting for the ROM upgrade for my 8K PET. I'll start to review an increasing number of programs and other products for the PET. As space permits, I'll also try to keep including programming hints and other interesting tidbits.

Since I do a lot of writing, I was happy to try the Commodore word processor programs. Having used several similar programs such as Script and Runoff on large time-sharing systems, I quickly became familiar with the Word Pro programs. Even if you haven't had any previous experience with word processors or text formatting, you should find the Commodore documentation easy to understand. The complete documentation was written using the program. It is included on the diskette so you can see real examples of how the program works. A little experimentation is all you need before you're ready to use the program.

About the same time I tried Word Pro, I discovered an error in the PET user manuals that Commodore wasn't aware of. There is an error in the parallel user port pin descriptions in the user manuals for all model PETs; the descriptions for pins 7 and 8 are reversed. Pin 7 should be the Common Tape Write line, and pin 8 should be the Tape #2 Read line. These lines are normally only used by the diagnostic routine when the diagnostic connector is plugged in and the PET is powered-on or reset. Commodore warns about using pins 1 to 12 of the user port for any other reason.

PETPILOT

PILOT has been mentioned in various articles, but not many people really know anything about the language. PETPILOT is a version of the original PILOT language, developed at the University of California, San Francisco, during 1968. PILOT was designed to easily write interactive teaching and testing programs with minimal restrictions on the format of the dialogue between the program and the user.

It is one of several languages classified as a computer-assisted instruction (CAI) language.

Available on more different computers than any other CAI language, PILOT provides opportunities for exchanging useful lessons. PETPILOT is completely compatible with the PILOT standard and includes an editor designed just for the PET. The editor creates lessons on tape, then PETPILOT reads and executes them. With short source updates for the new ROMs or the 16 and 32K models, the programs will run on any PET. PET BASIC is a fine general-purpose language, but it's not ideal for writing typical lessons that deal mostly with text and very little with calculation.

PETPILOT consists of a simple set of easy-to-learn-and-use instructions. They determine how PILOT will handle various text-manipulation operations to display text for the student, accept answers and try to match answers with a collection of stored responses to select the appropriate program. The PETPILOT teacher's manual clearly defines the various commands and provides many examples. The language is so simple that you need little or no computer programming experience to write a PETPILOT lesson.

Each PETPILOT instruction is a single letter followed by a colon and any required operand(s). Including a Y or an N between the letter and the colon can make any instruction conditional. The Y stands for yes and causes the instruction to execute only if the last response typed by the student matches the keywords in

the lesson. The N stands for no and works just the opposite; the instruction will execute only if the student's answer does not match the keywords. You can also use expressions or the value of numeric variables as conditioners, and the instruction will execute only if the expression is true (not zero). Expressions are enclosed in parentheses and included between the instruction letter and the colon, just as the Y and N are.

PETPILOT has numeric variables for storing numbers such as scores or counters, and text variables for storing student input or other variable text. Variable names must be at least two characters long and start with a letter. Numeric variables end with a number sign; string variables end with a dollar sign. All numeric variables start with a value of zero and all text variables start as null strings, as in BASIC.

You can also have labels on any PETPILOT instruction as targets of jump instructions or subroutine calls. Labels are first on a line and must not exist on a line by themselves. They start with an asterisk, followed by a letter, followed by as many letters and numbers as you can fit on the line and still have room for a PETPILOT instruction.

Briefly, the PETPILOT instructions are:

T: Display Text on Screen. Whatever text follows the colon is displayed on the screen. Each T instruction displays a single line of text on the next line of the screen. While displaying text with the T instruction, you can also display numeric or text values stored in variables, but only one variable can print per line.

A: Accept Student Answer. Accepts an answer from the student and optionally saves the answer in a variable for later use. The student can type any length response up to a full line of 40 characters. When the student hits RETURN to signify the end of the response, PETPILOT goes on to the next instruction.

M: Match Keywords with Last Answer. Matches each of the keywords following the colon of the M instruction with the last student answer. If any of the match items appear in the last input, the YES flag sets; otherwise, the NO flag sets. This is the basis for the Y-N conditioners mentioned earlier. The keywords are separated by commas, while blanks are important and affect how the lesson works. An item with a blank on both sides matches only if the student types it as a separate word. If no blanks are used, a successful match occurs, even if the item exists in the middle of a word.

By using two or more match instructions, you can comprehensively match student answers:

```
T: WHAT DID GEORGE WASHINGTON
T: DO TO THE CHERRY TREE?
A:
M:CUT,CHOP,
MY: DOWN ,
TY: RIGHT, HE CHOPPED IT DOWN.
```

This sample PETPILOT program requires an answer that contains the word DOWN and also the word CUT, CHOP or CHOPPED.

P: Print Text on Screen. Displays whatever text follows the colon, just as the T instruction does, except that values of variables in the text aren't substituted and displayed. This instruction does not appear in the core PILOT language. It is an extension available in PETPILOT and runs much quicker than the T instruction.

J: Jump to Another Instruction. Transfers the flow of your PETPILOT lesson to another location identified by an instruction label given after the colon of the J instruction. Whatever instruction is found there executes, and the lesson goes on from that point.

When a J instruction executes, PETPILOT first looks for the label in the portion of the program currently in memory. If PETPILOT finds the label, the lesson carries on from there. If it doesn't find the label, PETPILOT reads more of the lesson from the cassette tape until it finds the label or comes to the end of the lesson. When you have two or more identical labels, PETPILOT uses the first one it finds.

U: Use Subroutine. Control transfers to the instruction identified by the label. Execution continues from there until PETPILOT finds an E instruction, then control returns to the instruction following the U instruction. Since PETPILOT allows duplicate labels, particularly useful subroutines may repeat many places in a lesson so you don't need to jump too far. If necessary, you can nest subroutines up to ten levels deep.

E: End. End of subroutine or end of the lesson. This instruction can end the lesson no matter where it is encountered. It does not have to occur physically at the end of the lesson.

R: Remarks. This instruction has no action when you are running the lesson. Its only function is to provide a way to document a PETPILOT lesson.

C: Computation. This instruction increases the power of PETPILOT if you need to use the features of BASIC. You can use any legal BASIC line in a C instruction, but you must use numeric variables without the normal number sign at the end.

Two other PETPILOT instructions do not appear in the core PILOT language.

H: Clear Screen and Home Cursor.

F: Footnote and Wait. Moves the cursor to the last line of the screen, prints the message: PRESS RETURN TO GO ON and stops until you press the RETURN key. The screen clears and the cursor positions in the upper left-hand corner (home). This provides an easy way to wait for a student to finish reading a screen full of text before continuing.

Overall, well-documented PETPILOT should be ideal for its intended purpose. Even if you're not a teacher, PETPILOT, at its relatively low cost, may be a valuable addition to your program library. Currently, PETPILOT and the PETPILOT Editor must be licensed at $2 each for every machine they will run on. The license fee also includes a printed copy of the program source code that you can enter by hand. The *Teacher's Manual* is available for $5, and a double-sided reference card is $1. Better yet, a Teacher's Package that includes both licenses, teacher's manual, reference card, a tape with the Editor, PETPILOT language and a short demo program is $25. Prices are postpaid and include taxes when you order through Dave Gomberg, PETPILOT Project, 7 Gateview Court, San Francisco CA 94116. Program tapes are currently in short supply, but Commodore will distribute the program in the near future.

3G Light Pen

A self-contained light pen that plugs directly into the PET user port is available from the 3G Company, Rte. 3, Box 28A, Gaston OR 97119. The pen allows you to bypass the PET's keyboard and interact directly with the information on the CRT screen. It adds versatility to most graphic programs and opens up many unique game possibilities.

A user can display a "menu" on the screen and make a selection from the menu with the light pen. This type of simple interaction makes it easy for non-computer-oriented people to use an application program. Another valuable use of the pen is in educational programs. The pen allows a child to interact directly with the display without having to type or read. My three-year-old son could use the pen the first time he tried it.

The light pen is completely assembled and ready to plug into the PET. It uses three bits of the user port to interface to the PET. One bit resets the pen, while a second bit reads the pen status. The third bit supplies the power for the light-pen interface. A small PC board attaches directly to the user port connector and protects the interface components. The pen works with any model PET and with either the white or green phosphor displays.

Overall quality is good, and a sample program listing and programming instructions are included with the pen. The sample program isn't fancy; it simply displays a rectangle and a square with two cursors and asks you to pick the rectangle. The program does its job, however, and clearly shows how to use the light pen within a program and "debounce" the input to get the correct results.

The 3G Company sells the pen by mail-order with a 30-day, unconditional money-back guarantee for $29.95 plus $1.50 postage and handling ($6 outside the U.S. and Canada). Discounts are available for volume orders.

Programs are available for the light pen from at least three sources:

Quill Software
2512 Roblar Lane
Santa Clara CA 95051

Distinctive Interiors
6278 SW 14 Street
Miami FL 33144

Copytronics
Burgemeester van Suchtelenstraat 46
7413 XP Deventer HOLLAND

I hope to review programs from these companies in the near future.

Please address all correspondence concerning PET-pourri directly to Robert W. Baker, 15 Windsor Dr., Atco NJ 08004. Forwarding cannot be guaranteed for correspondence sent to Microcomputing.*—Editors.*

Next month, the PET-pourri column will look at a multiprocessor printer, and other PET-related new products, and PET programming techniques, as well as some comments from our readers.



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Harold Mauch
President, Percom Data Company

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✓17

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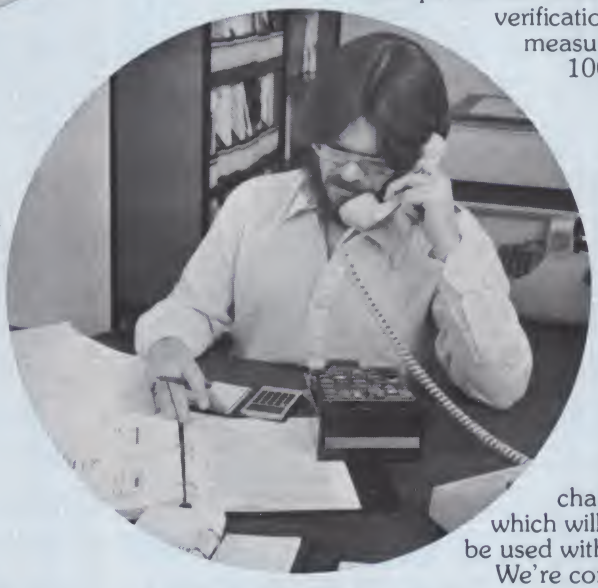
"From an efficient 1K-byte control system DOS to high level languages such as FORTRAN and Pascal, no other microcomputer disk systems manufacturer provides the range and quality of development and application programs available from Percom."





"Connie is running a 'cats eye' test on a mini-disk drive to check radial track alignment. Drive motor-speed timing and sensor alignment tests have already been performed. Disk formatting and format verification tests are next. These measurements are part of the 100% testing every single unit receives."

"Whether you call about a shipping date or ask a tough technical question, you get a competent courteous answer. Outstanding customer service is a hallmark of Percom."



"Richard's making final changes to a disk controller which will allow Percom drives to be used with yet another computer. We're constantly developing and introducing new products that extend and enhance the value of Percom systems."





"Slipping a circuit board through the eye of a needle would be easier than slipping a cold solder joint past Beverly. These are four-drive LFD-400/800 disk system controllers she's inspecting."

Edited by Dennis Brisson

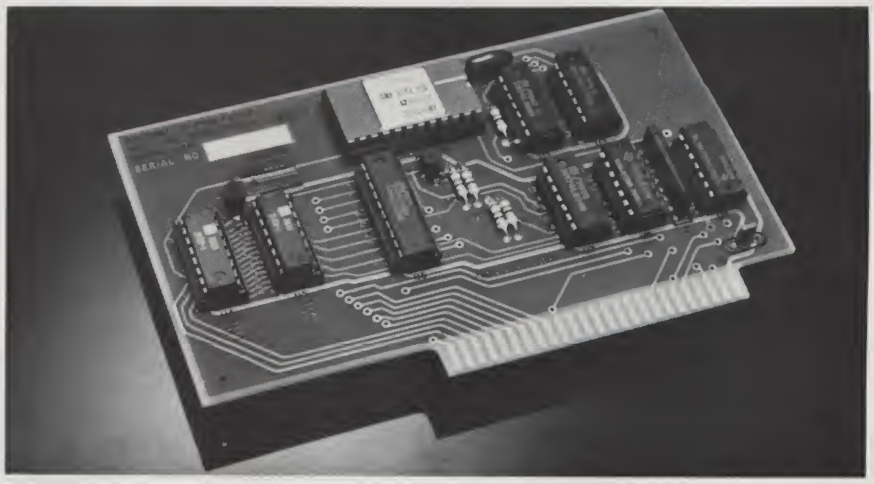
NEW PRODUCTS

Apple II Arithmetic Processor

The Model 7811B Arithmetic Processor Unit is designed to increase the execution speed of Applesoft II programs, as well as increase the number of math functions available to the programmer, and allows the Apple II to produce more complex high-resolution graphics. The card employs the AMD9511 APU. It is a hardware floating-point unit powerful enough to decrease program execution time by up to one order of magnitude. This arithmetic processor provides high performance on fixed- and floating-point arithmetic operations and on floating-point trigonometric operations.

The Model 7811B plugs into one of the Apple II expansion slots. The CCSoft interpreter is then loaded from the diskette provided with the board and the system is ready to execute programs written in Applesoft. The CCS 7811B maintains a precision of 6.5-plus significant digits and offers a range of approximately 10 ± 20. It is available fully assembled and tested.

California Computer Systems, 250 Caribbean Drive, Sunnyvale CA 94086. Reader Service number 476.



The Model 7811B.

6809-Based Business System

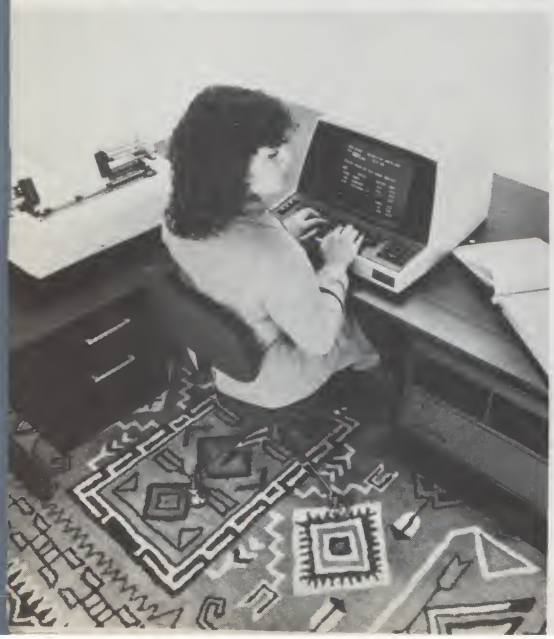
The 6809-based series of Chieftain Business Systems is configured around the Chieftain microcomputer with 64K of main memory and the DCB-4 disk controller capable of handling four 8-inch floppy disks, each storing a full megabyte of data. It features multi-user and 20 megabyte hard-disk options. The hard disk provides 10 megabytes of fixed and 10 megabytes of removable storage and can be accessed by up to four users.

By incorporating the 6809 microprocessor, you can run applications programs written in BASIC at over two and one-half times the speed of comparable 6800-based computers. These business systems also support COBOL, FORTRAN and UCSD Pascal. Up to sixteen 64K blocks of memory can be addressed, which allows up to one megabyte of memory to be accessed; the entire megabyte can be configured into 4K blocks.

The system's basic configuration also includes a 1920-character video display terminal and either a high-speed line printer or letter-quality daisywheel printer. Word-processing software is standard. Price ranges from $5000 to $8400, depending on disk storage and printer; the hard disk and multi-user options are an additional $8500.

Smoke Signal Broadcasting, 31336 Via Colinas, Westlake Village CA 91361. Reader Service number 479.

The Chieftain Business System.





The Microbox and Microstik from CJM.

Apple Controller

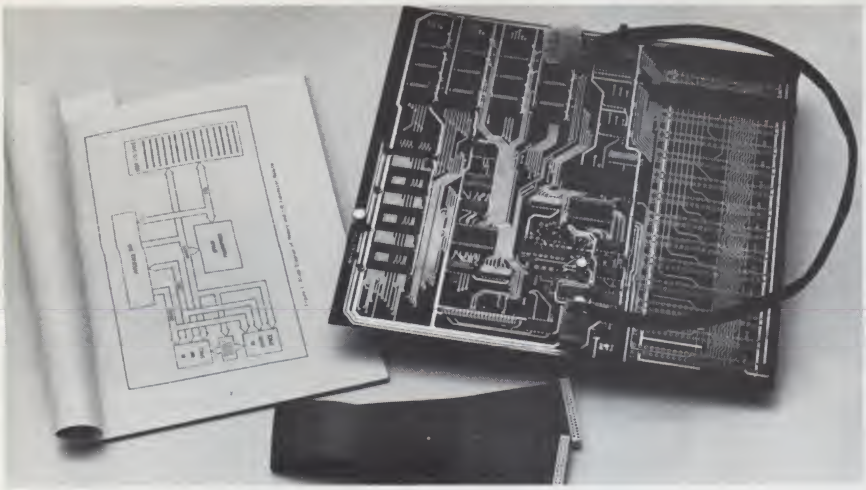
CJM Industries, Inc., 316B Victory Drive, Herndon Industrial Park, Herndon VA 22070, has announced the availability of two new products for the Apple computer.

The Microbox plugs into the Apple game socket. It has 4 ac outlets that can control external devices by simple commands from the keyboard or programs. Four LEDs provide visual status of each port or socket. Loads are switched by solid-state components that isolate and protect the Apple.

Two heavy-duty Jones plugs and sockets connect matching joystick modules, or Microstiks. Three push buttons provide additional external input to the Apple. Applications include: household appliance control, motor control/speed control, relay switching/solenoid switching, enhancing games and graphics input. A tutorial manual and demo cassette are included. Reader Service number 483.

University Module Expansion

MEM is a memory and I/O expansion module for the Texas Instruments University Module 16-bit microcomputer board from George Goode & Associates, Inc., 12840 Hillcrest Rd., Suite 113, Dallas TX 75230. The



The Memory and I/O Expansion Module.



The Model LM-1 Logic Monitor.

MEM can expand the University Module's available memory by an additional 8K bytes and CRU I/O address space by an additional 480 bits. An EPROM programmer with software driver, plus all the connectors, cables and integrated circuit components required to interface with the University Module, are included.

Accessories furnished include interface ICs, a power supply cable with matching connector and ribbon cable with adapters for the University Module expansion port and MEM connection port. A TM 990/519 power supply can provide +5 V, ±12 V voltages required for the memory components, with an additional power supply necessary for programming EPROMs. Price is $299. Reader Service number 480.

OSI Journal

PEEK(65), the unofficial Ohio Scientific users' journal, has begun publication. Features include a software exchange, Peeks and Pokes, user equipment reviews and bugs and fixes. Editorial contributions (articles and software or products for sale or exchange) are invited. One year's subscription (12 issues) costs $8.

PEEK(65), 62 Southgate Avenue, Annapolis MD 21401. Reader Service number 499.

Compact Computer from Chrislin

The CI-103 is a complete computer enclosed in a single compact cabinet (14½ x 18 x 14¼ inches). It includes a DEC VT100 Video Terminal, LSI 11/2 or LSI 11/23 CPU and 64K bytes to 256K bytes of high-speed memory. The unit has a detached typewriter-like keyboard. Digital Equipments' full line of PDP-11 software is currently available.

The LSI 11/2 with 64K bytes is $4500; the LSI 11/23 with 256K bytes is $9600. The DEC RX02 one megabyte floppy-disk system ($3045) or a 10 megabyte cartridge-disk system ($6100) is offered as an option.

Chrislin Industries, Inc., 31352 Via Colinas #102, Westlake Village CA 91361. Reader Service number 475.

Logic Monitor

The Model LM-1 Logic Monitor is a 16-channel digital test instrument designed specifically for use with 8-pin, 14-pin and 16-pin DIP ICs. The lightweight, clamshell-shaped clip attaches both mechanically and electrically to the pins of the IC and supports itself on the board. Sixteen numbered LEDs at the top of the clip light for high logic levels and stay off for low logic levels or unconnected pins. Pulse trains appear as less than full-intensity LED illumination, with relative brightness approximating pulse duty cycle.

The LM-1 is self-contained and circuit-powered. It automatically determines which pins see the highest and lowest voltages (since supply pin voltages will be slightly higher and lower, respectively, than high and low logic level voltages) and draws power from them. Its 1.8 V dc threshold voltage assures compatibility with TTL (5 V dc logic) and some CMOS logic levels. Price is $60.

Global Specialties Corporation, 70 Fulton Terrace, New Haven CT 06509. Reader Service number 477.

Smart Terminal

The Emulator is a new low-cost smart video display terminal designed with the terminal control codes of four other popular CRTs—the

Chrislin's latest computer, the CI-103.





The Emulator terminal.



The ETS-2000 system.

Lear Siegler ADM-3A, the DEC VT-52, the Hazeltine 1500 series and the Soroc IQ-120. It also includes other features not found in these models, such as an auxiliary RS-232C printer port, visual attributes, a full numeric keypad, a 12-inch non-glare screen and a special user-displayable terminal status line.

The Emulator operates through the range of 50–9600 bps and features a full 24-line × 80-column display. The unit also incorporates a modular design utilizing only three modules to facilitate field maintenance.

Intertec Data Systems, 2300 Broad River Rd., Columbia SC 29210. Reader Service number 484.

Computerist/Investor Journal

The *MicroComputer Investor* is the journal of the MicroComputer Investors Association (MCIA), which was founded in 1976 as a professional, nonprofit association of persons who utilize microcomputers in making and managing investments. All back issues of the journal are available to new members. Each journal contains narratives, together with computer programs that implement diverse aspects of investment management. To obtain an information packet, send $2 to J. Williams, MCIA, 902 Anderson Drive, Fredericksburg VA 22401. Reader Service number 497.

Interactive Video Training System

The ETS-2000 is the first interactive video system designed for implementation on existing equipment. It is plug compatible with the Industrial Betamax Video Recorder and most microcomputer systems currently in use. Combining the power of computer control and response with the impact of video, this system frees the instructor from the drudgery of repetitious lessons, scoring and analysis of testing. Existing programs are easily adapted by the novice user through plain-English commands; no computer programming is required.

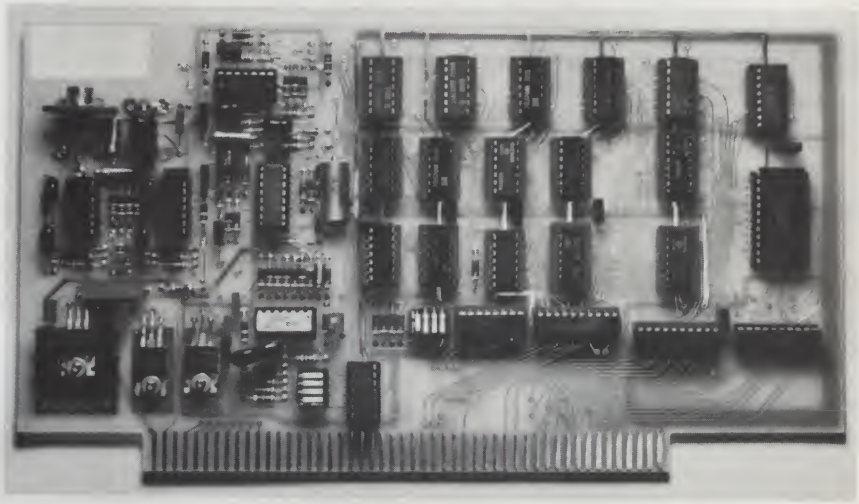
You can train, score and analyze up to 30 students at one time through the MRC-2001 peripheral. The ETS-2000 can be added to existing Betamax recorders and most microcomputers for less than $600 in the single user mode. The MRC-2001 costs from $700 to $1200.

General Technical Corporation, 6105 Myer Street, Tampa FL 33614. Reader Service number 482.

Speech Board for S-100 Computers

Now you can give your computer a voice with the Articulator circuit board from Quintrex, Inc., 9185 Bond, Overland Park KS 66214. The Articulator converts analog (speech) input from a standard dynamic microphone into bytes of binary data that may be stored in the computer's main memory on disk or on tape. The digitized speech can then be fed back into the Articulator board from the computer to reproduce the original voice input. Thus, the S-100 computer can be programmed to repeat a vocabulary of any language, limited only by the computer's peripheral storage capacity.

Software to control the Articulator involves a single command byte sent to the command port controls encoding/playback, vox/no vox switching and single-byte/eight-byte mode. When a bit is set in the status register, a byte is sent to or received from the Articulator through the data port. The status bit may be jumpered to one of the S-100 vectored interrupt pins for those systems with the interrupt controllers. Reader Service number 481.



The Articulator board.

How's your love life?



A little dull around the edges? Routine? Predictable? Boring? Maybe all it needs is a little Interlude. Interlude is the most stimulating computer game ever conceived. It combines a computer interview, an innovative programming concept, and a one-of-a-kind manual to turn your love life into exciting, adventurous, delicious fun!

Interlude is: romantic . . . playful . . . outrageous . . . a fantasy. Interlude is: ■ Wet fun on a hot summer night. (Interlude #21) ■ A surprise on the way home from dinner. (Interlude #42) ■ A bubble bath that ends with a bang. (Interlude #78) ■ An evening to rest while she does all the "work." (Interlude #25) ■ The most romantic of evenings. (Interlude #84) ■ A new twist to an old subject. (Interlude #69) ■ Just watching her . . . (Interlude #57) ■ An erotic fantasy! (Interlude #33)

With over 100 Interludes, you can satisfy all levels of interest and desire. Each Interlude is fully described in the manual, and the more elaborate ones are detailed with regard to settings, props, and mood-enhancing techniques. But we've saved a few super Interludes for that very special time when your interview indicates you're ready! At that time, you will be introduced to one of several Interludes held secret within the computer. (When you learn secret Interlude #99, your love life may never be the same again!) Interlude can give you experiences you'll never forget. Are you ready for it?

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Edited by Dennis Brisson

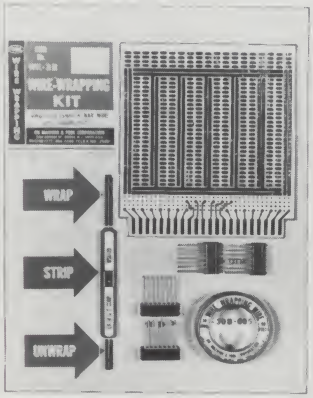
NEW SOFTWARE

Wire-Wrapping Kit

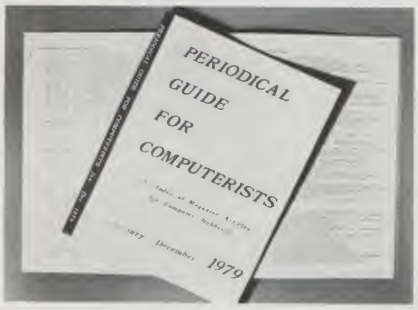
OK Machine and Tool Corp., 3455 Conner St., Bronx NY 10475, has released a new wire-wrapping kit (model WK-3B) that includes the following:

- a wire-wrapping tool (model WSU-30) that wraps and unwraps 30 AWG (0, 25 mm) wire on .025 (0, 63 mm) square pins and strips 30 AWG wire using a built-in stripper.
- a 50 ft. roll of Kynar-insulated silver-plated copper wire-wrapping wire.
- two 14-pin DIP sockets and two 16-pin DIP sockets for plug-in packaging of integrated circuits.
- a PC board (4 x 4½ inches) with copper pads and 22/22 edge connector contacts.

Price is $16.95. Reader Service number 478.



OK's wire-wrapping package.



Periodical Guide for Computerists.

Computer Articles Index

The January–December 1979 *Periodical Guide for Computerists* indexes over 3000 articles from 24 personal computing and professional electronic publications. Articles, editorials, book reviews and letters from readers which have relevance to the personal computing field are indexed by subject under 120 categories. A list of the authors is cross-referenced by subject to aid in locating articles. The 80-page book is available for $5.95 from E. Berg Publications, 622 East Third, Kimball NE 69145. Reader Service number 498.

Psych-Up

Psych-up is a program that allows SWTP 6800 owners to run Flex 9.0 software on their systems that have been upgraded with a Percom adapter module and PSYMON monitor for 6809 operation. It resolves all Flex incompatibilities without hardware modifications. The software modification is accomplished using a two-drive SWTP MF-68 mini-disk system. Unmodified versions of both Flex 2.0 and Flex 9.0 (available from Technical Systems Consultants) are required. Psych-up is supplied on minidiskette along with application instructions for $29.95.

Percom Data Company, 211 N. Kirby, Garland TX 75042. Reader Service number 496.

Personal Business Software

Personal Software, Inc., 592 Weddell Drive, Sunnyvale CA 94086, announces the following four business packages:

- CCA Data Management System allows you to easily maintain data files, customer or employee records or inventory information. Driven by menus that prompt the user for information at each step, the program for the TRS-80 and Apple II eliminates the need to write custom programs in BASIC for defining, updating, storing and printing lists or mailing labels.
- Desktop Plan, intended for financial analysts who may be time-sharing on a large computer, makes it easy to create and use models of complex business systems in planning decisions. Requires 32K Apple II and Apple II Plus with Applesoft BASIC in ROM.
- TrendCalc performs regression analysis of time-series data and executes transformations such as moving averages and exponential data smoothing.
- VisiPlot, a graphics package, automatically creates scales and labels axes for bar graphs, pie charts and other visuals in multiple colors and windows. Both programs run on 48K Apple II and Apple II Plus. Reader Service number 495.

TRS-80 DBM

IDM-M2 is an interactive data manager for the TRS-80 Mod-II. It allows many applications to be computerized without any user programming.

The basic components of IDM are:

- the data initialization sub-system—lets you specify the file parameters on-line, such as the name, type, size of a field or number of records.
- the data manipulation sub-system—lets you add, display, print, delete or update a record.
- the report writer—lets you specify the format of a report on-line.
- the report generator—enables the user to produce up to ten standard reports or reports previously specified by the report writer and saved on disk.

IDM-M2 requires 64K memory. Price is $199.

Micro Architect, 96 Dothan St., Arlington MA 02174. Reader Service number 491.

Income Property Analysis Program

The Income Property Cashflow/Leverage Analysis program aids investors and real estate brokers in making knowledgeable decisions about buying or selling income property. It analyzes the effects of insurance, property taxes, utility expenses, interest payments, closing costs and debt service on the total purchase costs, as well as the total monthly payment. The analysis also calculates the return on investment and the actual leverage achieved based on a user-estimated annual appreciation rate.

You can analyze many formats by varying the amounts of down payment, second financing, interest rates, rental income and other purchase criteria. The program permits reviews of several potential investments, allowing a thorough financial comparison of the properties involved and an analysis of the best method of financing. Price is $30, cassette, $35, diskette. Available for the Apple II and TRS-80 Level II.

Realty Software Company, 2045 Manhattan Avenue, Hermosa Beach CA 90254. Reader Service number 487.

Apple File Management System

The Apple File Management System (FMS) allows compressed data files and indexed sequential files to help solve limited disk storage problems for the Apple II. If still more space is required, a multi-volume, multi-drive version of FMS that can support files of up to 16 million bytes on up to 255 different diskettes and a Corvus disk version of the software that can handle files spanning the entire disk are available.

You can use Apple disks in any of three

modes: indexed-sequential, random or sequential. FMS builds and maintains an index to all files permitting the location and fetching of any record with at most one disk access, regardless of the length of the file. The data is continuously sorted into "key order" at machine-language speed with no user intervention required.

FMS permits variable-length records of up to 8192 bytes, and record keys may be of any length and composition—real number, integer, string or any combination. To minimize disk activity, the user sets the number of sectors to be read or written at each disk access. Prices are $195 for FMS, $295 for the multi-volume, multi-disk version and $395 for the Corvus disk version.

Alpine Software, Inc., 4874 Ridenour Drive, Colorado Springs CO 80916. Reader Service number 494.

Invaders

Invaders is a new program for the TRS-80 Level II 16K that tests your skills in defending the earth against aliens who are marching down across your screen and dropping bombs trying to destroy you. Because the program is written in machine language, the response time is quick. Complete with sound effects, the program keeps track of and displays, at the end of each game, the current score, previous score, highest score (or new high score), hits, shots and misses. Price is $14.95, cassette, $19.95, disk.

Level IV Products, Inc., 32238 Schoolcraft, Suite F4, Livonia MI 48154. Reader Service number 488.

North Star Software

North Star Computers, Inc., 1440 Fourth Street, Berkeley CA 94710, has introduced four application software packages for North Star's Horizon microcomputer.

- NorthWord is a word processor that includes easy entry and editing, on-screen text formatting and simultaneous document printing. It can be used with the North Star mail list management program to produce customized letters, labels and reports. This screen-oriented program presents an activities menu on the screen to make selection by the operator a simple procedure.
- MailManager, the North Star mail list management package, compiles and maintains complete organized mailing lists. Entries, corrections and deletions are easily made, with the correct order always being maintained by MailManager. It allows up to ten data items for each name in the list to sort or select.
- InfoManager is a list-oriented information management system that will accept up to 50 categories of information for each record and has the ability to select and sort before printing.
- GeneralLedger includes the general ledger and financial reporting programs. It maintains general ledger accounts based on such input as checks, bank deposits and journal entries. Then, it can combine with NorthWord to use the information in the general ledger to produce customized financial statements and reports. These packages require two drives and 64K RAM. Prices are NorthWord, $399; MailManager, $299; InfoManager, $499; GeneralLedger, $999. Reader Service number 486.

Apple Education Software

Study Quiz Files—enables a teacher to create, save, retrieve, revise or run study quizzes on any subject without any programming knowledge.

Multiple Choice Files—is a similar program for multiple-choice tests. Both contain randomized questioning and immediate feedback learning strategies. Missed items are re-presented until all questions are answered correctly. The programs include color graphics, name displays and sound effects for positive reinforcement.

Apple-cations, 21650 W. Eleven Mile Rd., Southfield MI 48076. Reader Service number 489.

Math Software—1233 Blackthorn Place, Deerfield IL 60015, has recently released ten prepackaged programs that graphically demonstrate math concepts on the Apple II. These programs, which are valuable for classroom instruction, are: Arithmetic of Functions, Rational Function Grapher, Sine and Cosine Grapher, Graphic Integration Theory, Solids of Revolution, Midpoint Rule and Trapezoid Rule, Limacons and their Areas, Limits of Sequences, Polar Graphing and Area under a Curve. These programs, which cost $15 each, require 32K with disk drive. Reader Service number 485.

Elementary Math Edu-Disk—contains an arithmetic readiness test and four interactive lessons designed to teach elementary addition, subtraction, multiplication and division on nine different skill levels. These lessons are rich in interactive tutorials and use extensive color graphics and a computer-simulated voice to maintain student interest and reinforce basic concepts. The student's scores are maintained on disk and are accessible only through a special teacher's program (included).

The program for the Apple II 48K is self-demonstrating and requires little or no instructor assistance. It is recommended for the student with no prior arithmetic experience and as a supplement in higher-level remedial situations. Disk price is $39.95.

Muse Software, 330 N. Charles St., Baltimore MD 21201. Reader Service number 492.

Typesetting Program for PET

Now you can turn your Commodore PET or CBM computer into an editing-typesetting terminal with the Type-Share package. With your computer as the front end of a high-speed phototypesetting system, you can set newsletters, books and other publications with this system at a fraction of the cost charged by commercial typesetters. To use the program, just load it into your computer, and an interactive dialog aids you in setting up the initial coding for typesetting. Then, once the coding is complete, simply keyboard your copy, along with additional coding for the typesetter. You can determine the typesetting parameters such as type style, point size, line length, spacing and format (justified, ragged right or left or centered copy).

After you have typed the copy and stored it on tape or disk, it can be read back into memory for proofing, editing and coding. Systems with a printer can produce a hard copy of the material for off-line review. To process the completed tapes or disks, you must send them to Type-Share, 8315 Firestone Blvd., Downey CA 90241. The Type-Share program on tape cassette or disk and complete instructions cost $250. Reader Service number 493.



The latest software from North Star.

BOOK REVIEWS

All About Telephones

Van Waterford
TAB Books, Blue Ridge Summit PA
190 pp.

I find that most computer hobbyists have no knowledge of telephone electronics. This is unfortunate since the telephone has potential for any experimenter, and particularly for the computerist. It can be used both to transmit data and as a peripheral device to control various functions in the house from afar. I, too, was relatively ignorant of the internal workings of Ma Bell's "black box," and I was glad to see TAB Books' recent addition, *All About Telephones*, by Van Waterford.

Waterford's apparent purpose in writing this book is to show you what is available from outside the Bell System and how to connect it legally to your system. However, he starts with a history of the telephone and illustrates this chapter with many relevant and interesting photographs. He goes through the development of the telephone itself, and then of the networks and grids.

The chapters that prompted me to buy the book were those on the actual workings of the telephone. Waterford presents electronics theory understandably, then discusses various parts of the phone such as the dial, transmitter and receiver. The most practical information the author gives is telling you which wire to connect to which terminal. You won't build your own telephone by using this information, but you will know what each part of your telephone does.

In chapter four, Waterford explains the new FCC regulations as they apply to telephones. He describes what you can do and what the telephone company must do for you. However, for non-American readers like me, it was not relevant. I believe that the author's explanations of the law are factual.

The rest of the book is devoted to devices you can attach to your home telephone system. This is where the book really shines, and is obviously Waterford's pet subject.

He describes various options that can replace or extend the usefulness of your phone: automatic dialers, answering devices, burglar alarms. This section should be more useful to a person living outside a large metropolitan area with numerous electronics stores. Waterford gives only minimal information on attaching these devices, but it is sufficient to let you know whether you will need to hire a more qualified person. This is relevant when you decide what the device will really cost.

The author concludes with the "mandatory" chapter on the future. Here he presents the usual array of wonders from Bell Labs. It sounds like a commercial!

In summary, this is a clearly written and well-illustrated book that deals with connecting readily available devices to your telephone system. The author presents a lengthy and helpful description of many of these. Although the book gives a basic description of the workings of a telephone, it is not a do-it-yourself manual to enable the reader to create his own interfaces to the Bell System or to build his own peripheral devices.

Bruce Robert Evans
Pickering Ontario
Canada

Atari BASIC

Albrecht, Finkel and Brown
John Wiley and Sons, Inc.
New York, 1979
Softbound, 332 pp., $5.95

Back in the old days (1977) you were lucky to get a legible schematic with your new computer kit. Now you can get all the information you can possibly need without even buying a computer. The latest wave in the flood of documentation is *Atari BASIC* from Wiley.

I ordered an Atari 800 in December 1979, so when I saw this book, I decided to get a head start on using my new system. (This book is included with both the 400 and 800, but at $5.95 I figured I could afford to give away my extra copy when the computer came.) When I sat down with *Atari BASIC*, I was both disappointed and pleased.

Albrecht et al have produced what may be the finest introduction to BASIC programming I have ever seen, and that includes the TRS-80 Level I manual. Like the Radio Shack manual, *Atari BASIC* is a programmed-instruction text. Short discussions of various topics are followed by examples and then questions or problems to solve. The answers or solutions are immediately below the problems. As with any text of this kind, it can be used without the computer. You'll find it rather dry without the immediate reinforcement provided by actually keying in the examples, though.

It is clear that Atari has learned the Radio Shack lesson. The novice computer owner will find no problem at all learning to program his Atari system, though he may be intimidated by the thickness of *Atari BASIC* at first. According to the second chapter, "Getting Started," Atari also supplies an *Operator's Manual* with each computer. Presumably this book contains some of the omissions from *Atari BASIC*.

There lies my only gripe about *Atari BASIC*. The authors have left out even the most minimal summary of program statements. The book contains no information on using any direct commands such as CSAVE or AUTO, or even tells if these commands exist. The unique part of the BASIC dialect Atari uses, such as the graphics commands and the SOUND function, are poorly explained. For example, page 284 informs you that there are eight graphics modes. The next page lists some of them: 3, 4 and 5, and 6 and 7.

You already know about mode zero, but what about modes 1 and 2? Why are the last four listed as pairs? Exactly what does the COLOR keyword do? It's mentioned as necessary but never discussed. A summary of keywords and their functions would only require a few pages in an appendix.

Buy this book, however, if you've never programmed a computer before but are thinking of buying an Atari. At $5.95, *Atari BASIC* is a good introduction to programming (if you buy the computer for your family, you'll probably need another copy of the book anyway). If you are already an experienced hobbyist, don't bother. This is *not* a reference book. As an introductory text, it is almost unsurpassed; as a computer manual, it's a dud.

William Colsher
Lisle IL

Sixty Challenging Problems with BASIC Solutions

Donald D. Spencer
Second Edition, 1979
Hayden Book Company, Inc.
Rochelle Park NJ
$6.95, softbound, 128 pp.

Mr. Spencer has, again, compiled a book devoted to simple BASIC routines using the familiar headings of business/science problems, games, mathematical recreations and puzzles. BASIC-programs-type books such as Spencer's 1975 Hayden publication, *Game Playing with Computers*, generally reinvent the wheel; the same type of problems are "solved" again and again.

Sixty Challenging Problems with BASIC Solutions is divided into two major sections. The first presents a problem by way of a short definition of the particular formula that can be used, then asks the reader to "Write a BASIC program. . . ." The second section is a TTY-format listing and sample run of the problem solution in a BASIC format. This sectionalized format seems to be the only difference between this book and others I have read which ask the reader to write a BASIC program to solve a particular problem. Some funny illustrations

lend a little humor to this particular book; however, it is not intended to be comic.

Following is a list of some of the routines included in this book. The word "routine," not "program," should be employed since these listings should be used as simple subroutines rather than full-fledged programs.

Armstrong numbers, amicable numbers, Fibonacci numbers, perfect numbers, prime numbers and so on are again given the treatment. Greatest common divisor and least common multiple, as well as factoring, pairs of factors and N factorial, are here for those of us who missed them the first time. The Chinese Remainder Theorem and a few number-guessing games are also included. Other random-number-based routines include: Sam the Drunk (a random walk), Bullseye (shoot an arrow), a few dice-throwing games and the coin-toss.

Magic Squares are given the once-over, and a few interest-calculation routines are presented. An altitude-conversion (feet to miles) and a population-calculation routine round out the remaining "challenging problems."

If you already have any introductory BASIC problem-solving book on your shelf, there's no reason to buy another. The proliferation of these books presents a diluted and simple view of what can be done with a microcomputer. When you've seen one of these publications, you've seen them all.

Len Gorney
Clarks Summit PA

LETTERS TO THE EDITOR

High Marks for "Benchmarks"

I have just read "Assembly-Language Benchmarks," by Allan Flippin, in the March 1980 issue. Congratulations on a well-thought-out and executed comparison. It is one of the more objective evaluations of processors I have seen.

As a systems engineer involved with the 990/9900 family at Texas Instruments, I want to point out that a 3 MHz 9900 was used in this study. The current 9900 is 4 MHz and will therefore perform better. With 220–250 ns memory, the 9900 does a memory cycle in two CPU cycles. At 3 MHz, this takes approximately 667 ns, but at 4 MHz it is cut to 500 ns—a ¾ scaling. Non-memory cycles are also linearly scaled to ¾ of the time.

If you apply this ¾ scale factor to the times in your tables, you get the new results in Table 1.

I also want to comment on the remark that the 9900 architecture is inherently slow because of the workspace concept. It is certainly true that registers on the chip are faster than main memory, but there is definite programming convenience in being able to define a set of registers anywhere in memory. This especially shows up in applications requiring a lot of context switches.

However, *our own* studies in the minicomputer division caused us to decide that the advantages of faster "real" registers were needed, especially in the commercial environment. As a result, the latest "mini" version of the 990, the /12, has a fast cache memory for the workspace. As registers are written, they go into the cache; if one that has not been written to since the last context switch is read, then a cache controller does a memory cycle to bring in the value. When a context switch is performed, all the registers flagged as changed or "dirty" are written to memory by the /12 microcode.

Benchmark	Old Time (us)	Old Rank	New time (us)	New Rank
lookup table	193	#8	145	#6
block move	2342	#8	1757	#6
jump table	23	#8	17	#6
multiply	14	#2	11	#2

Table 1.

It can be shown that this is always as efficient or better than having "real" registers that the programmer must explicitly manage. The saving and restoring must always occur—in the /12, the hardware does it instead of the programmer.

I cannot promise anything about new versions of the 9900; that is the semiconductor group's responsibility. Nevertheless, it should be clear that either the same sort of caching or simply having some fast memory on the chip and leaving the workspace in that memory would solve the register "problem" of the 990/9900 architecture.

Once again, I congratulate you on a well-written article. I especially enjoyed the comments on the ease of programming the various processors. I hope my comments here will clarify the position of the 9900 in the performance spectrum.

Laurence C. Brevard
Systems Engineer
Austin TX

Happy with the H8

I essentially agree with the comments made by Thomas Prewitt regarding the construction of the Heath H14 line printer (February 1980 issue, p. 98). It took me about 30 hours to build the printer; I only made one mistake. You have to be careful in running the wires from the small stepper motor board to the main board—it is easy to solder a wire in the wrong hole.

Prewitt's comment about the numerous errata sheets was not true in my kit. Heath's documentation is super. Be careful, follow their instructions to the letter and you cannot go wrong.

If you plan to use RS-232, be sure to follow the enclosed sheets on this. I misread them and thought the modification was not necessary, so I had to make the modification after I built the printer. Heath uses RTS for an output, which is not RS-232 standard. I switched this to the CTS pin and had no problems with the handshaking. I run the printer at full speed on my home-brew system.

The only serious problem with the printer occurred about a month after I started using it. On the harness running from the printhead to the main circuit about ¾ inch from the head, two of the wires were cut causing two needles to quit printing. The wires rubbing against the plate that holds the ribbon motor caused this. I hope the tape I put on the edge of this plate will remove the problem.

Otherwise, I am pleased with the printer. For the money, you obtain an excellent printer for home use.

Cecil Fretwell
Waterloo IA

Instruction on Instruction Sets

I want to congratulate you on your March and April issues. I particularly enjoyed the articles comparing the popular microprocessors. However, I found a couple of bugs in Hal T. Gordon's articles comparing instruction sets.

In the March article, Mr. Gordon states that Z-80 relative jumps are faster than absolute jumps, but actually, the opposite is true. This is because the processor must perform an addition before it takes the jump, which in the Z-80 takes longer to do than fetching the extra byte of the absolute jump. This addition time may vary with other processors, but I know that the 6800 also requires more time for a relative jump than for an absolute jump.

Another oversight in the articles is failure to mention the port I/O of the 8080 and Z-80. Any SWTP 6800 owner who must change his port addresses to add more than 32K of RAM is

made aware of the advantage of port I/O, which uses no memory space.

The real oversight I wish to talk about is not Mr. Gordon's, however, but the manufacturers'. At the end of the April article, Hal states, "The older designs . . . have become obsolete." Maybe they are obsolete, but their potential is far from being fully realized. To illustrate, in a recent issue of *EDN* magazine, an article presented a new 8-bit multiplication routine for the 8080 that runs 60 percent faster than the shift-and-rotate method usually used. Same old hardware . . . new software.

The manufacturers keep cranking out newer and more powerful processors with their tremendous resources, while comparatively little is spent on software. Software lags way behind, and even the 8080 has potential yet untapped. I've upgraded my H8 to a Z-80, but I'm still working with just the 8080 instruction set because, as simple as it is, I still have a lot to learn about what it can do.

I guess the message I want to convey is that we all have a lot to do and learn because our computers aren't much use without good software.

Patrick Swayne
Sebastopol CA

Serial Lover

I want to compliment you on your series of articles on the SWTP computer system by Peter Stark. They have been the best and most comprehensive coverage of a computer system that I have found in any microcomputer publication. As director of the 6800 user's group of our local computer club, I hear these articles referenced frequently.

Buren Shields
Albuquerque NM

Glasses Improve Posture

Since I spend a lot of time sitting at my TRS-80, I realized that my spinal column was beginning to take on some painful new twists. Although the source of the problem is obvious, it is worth mentioning.

Reading and writing at a microcomputer or at a CRT terminal demand a different body posture than reading and writing at an ordinary desk, even if the latter is complete with typewriter, because the CRT is generally at eye level or, at best, slightly below it. This means the eyes have to make a lot of vertical movements.

My pains in the neck occur because I wear bifocals. I was spending a lot of time tipping my head back in order to focus the CRT. Since my eyeglasses were designed for "normal" reading distance, I was hunching my shoulders forward to compensate for the "extra" distance to the CRT.

Once I discovered the problem, the solution was easy. I had a colleague measure the distance from my eyes to the CRT as I sat in a comfortable position before it. Then I went to my optometrist and had him make up a set of "reading" glasses with focal points at the measured distance. Since he essentially used my "regular" prescription and put the glasses in cheap, but comfortable, plastic frames, the cost was hardly more than I would pay for a good game program or two.

Now whenever I sit down for a long session at the keyboard, I change into my "computing glasses," which allow me to look back and forth from keyboard to CRT without redesigning my cervical vertebrae into a pretzel.

Edwin Dethlefsen
Williamsburg VA

Re-view

I bought *57 Practical Programs & Games in BASIC*, which was reviewed in the February 1980 issue. The outside looks great. In the preface, I learn that the programs were probably "tested" on a 370-158 system. A section entitled "BASIC Statements" looks as though it came right out of a large-scale-system book. The same is true of the BASIC command functions—looks like something to fill up pages. The first program is entitled "Annular Sections," and the book goes downhill from there: poor English, incorrect formulae, incorrect flowchart symbols.

Your reviewer states that the book "is well written and laid out." It is not. The book does not have a "description followed by . . . mathematical formulae used" that is worth anything. And, as for the programs being useful—hogwash. Someone with the creativity of a brick could think up a more useful set of programs.

I could have gotten my $3.95 back, I'm sure —but that is not the point. The point is that something that is worthless is being sold nationwide, in a "high visibility area," right next to where most of these people bought their computers!

C. Brian Honess W4OAB
Columbia SC

Additional Indexing Features

I knew that it was possible to make a directory program, but I never got around to it. However, the fine article by Jerry Dunmire ("Indexing for the PET," April 1980) revived my memory. When I first saw the blurb for the article, I thought it was another "add an index counter by the use of a lot of gears and holes" article. To my surprise, it was a software solution. Of course! With this directory, program-hunting is faster.

I have added a couple features that your readers might like. For a tape name, simply add a 90 READ F$:PRINT"DIRECTORY FOR: ";F$. To display the index as it fast-forwards, see Example 1. To have an automatic LOAD, change 270 POKE 527,131:POKE 525,1 for the old PETs, and 270 POKE 623,131: POKE 158,1 for the new PETs.

```
220 TI$="000000":REM RESETS TI TO ZERO
230 IF A<TI THEN PRINT "q";TI:GOTO 230
```

Example 1. (Lowercase q is the cursor.)

This last change pokes the LOAD/RUN character into the buffer and then tells the PET that one key has been pressed and is waiting in the buffer. When the program ends, the LOAD /RUN is forced into the buffer, and all the user has to do is press PLAY.

Mits Hadeishi
Gardena CA

Capitalization is Basic

I arrived in Raleigh NC in June 1977 to found Carolina Information Systems, Inc. I had $5000 to begin the business. By the time we opened our doors on August 15, 1977, I had raised another $5000 for a total initial capital investment of $10,000. Although I have continued to seek and receive investments, the total invested in our company is still just at $40,000. That the store and company are still here, and just beginning to show a small profit to compensate for our early losses, is sufficient testimony to my ability. This is an industry where computer stores had better have $100,000 or forget it.

Although I am familiar with the long list of manufacturers who have folded, and the legitimate criticisms of poor management at the retail level, I am sympathetic with the management of firms no longer with us. I know that I have made serious mistakes that would have been serious mistakes even if I was adequately capitalized, but I also know how much of what an outsider calls poor management in my firm is due to a lack of adequate resources to do the job the way we know it should be done.

As a Xitan dealer, I remember the six to nine months that the Xitan people were unable to deliver products because of the inability to obtain several critical chips on their sophisticated memory boards. Xitan never recovered from those months in late 1977, and the company died in 1978. Perhaps it was bad management not to have enough money to do what they needed to do, but a larger firm would have survived even if it hadn't made a single different management decision.

At some point we gamble, and if we lose we are bad managers; if we win we are the American dream.

In my case, I think we have succeeded, not won. The company is alive, but it will be two more years before it is out of the hole it dug during the first two years. My own interests are more in microcomputers themselves, and their academic uses, than in the day-to-day grind of creating solvency when you are only just barely solvent. The challenges were exciting for a while, but the routine is petty. When you are inadequately financed, you can't take advantage of the opportunities this industry offers. I needed, and still need, a different level of challenge.

(see LETTERS, page 225)



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Ramon Zamora, Recreational Computing Issue 4

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Captain 80, 80 Microcomputing Issue 1

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175 Main St.
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136 Ogden Ave.
Downers Grove, IL 60515
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Spring Valley, NY 10977
914-425-1535

Apple trademark, Apple Corp., TRS-80 is a product of Radio Shack, a division of Tandy Corp., Sorcerer trademark is a product of Exidy Corp., and Pet trademark is a product of Commodore Corp.

Reader Service—see page 257

KILOBAUD KLASSROOM NO. 19

Finally . . .
The Kilobaud Klassroom Krescendo

For all of you who have waited so long and patiently, Kilobaud Klassroom resumes at the stage where you can build your own microcomputer system. Sorry for the delay—here we go.

Peter A. Stark
PO Box 209
Mt. Kisco NY 10549

Kilobaud Klassroom has been working up to the point where we could build our own microcomputer system. We have finally reached that stage.

Up until the last installment of Kilobaud Klassroom—back in May 1979—we intended to construct a single-board computer that had a Tiny BASIC in one ROM chip. With 2K of RAM and a 4K BASIC, we could run real programs.

We had a computer all built, complete with a printed circuit board, before we found that the Tiny BASIC ROM chip was difficult to get. We had one ROM but couldn't get a second one. We waited and waited, hoping that some other manufacturer would come out with a BASIC in one ROM that we could use. We have not had any luck (although Motorola is planning such a BASIC for the 6809 chip).

Rather than aim for a small, but general-purpose, single-board computer (a product that is already well covered by a number of commercial designs), we decided to aim for something our readers probably didn't yet have and quite likely couldn't buy: an inexpensive, dedicated control computer that could be used for a variety of jobs.

The Kilobaud Klassroom Komputer

The photos show the simple configuration of the computer; in its simplest form it uses just four ICs. The block diagram in Fig. 1 shows how these four fit together.

The CPU is a Motorola 6802, which is currently available for under $20 from several *Kilobaud Microcomputing* advertisers; if you read the fine print you may find one as low as $12. The 6802 is program-compatible with the 6800. That means that the 6802 will run exactly the same programs as the popular 6800, but it has a simpler clock circuit and

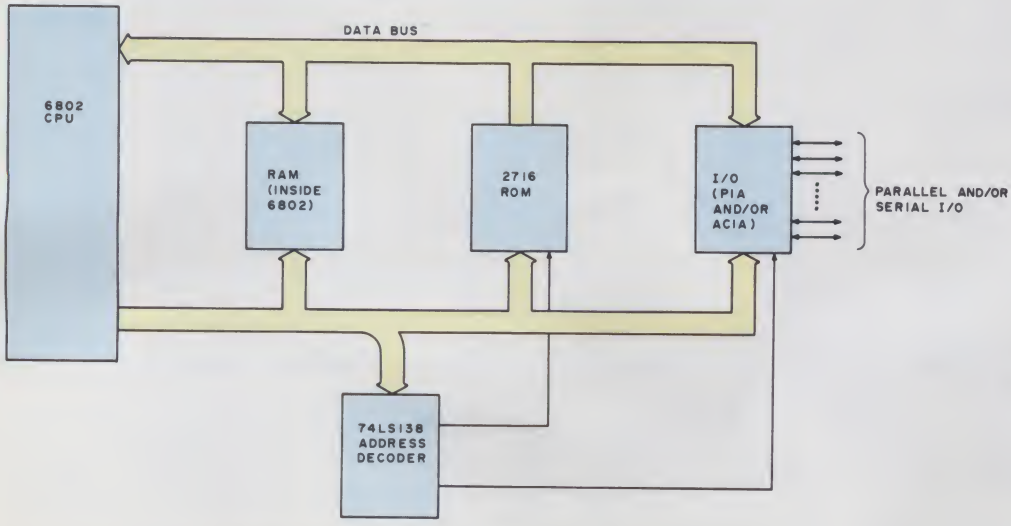
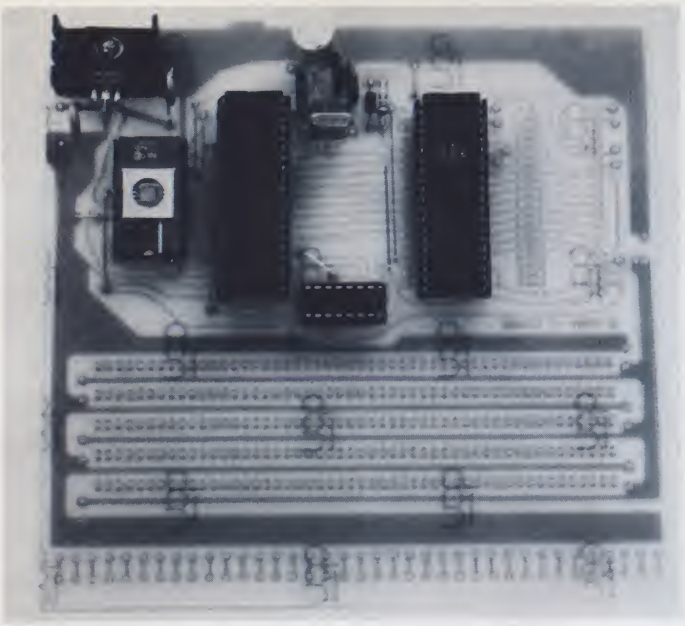
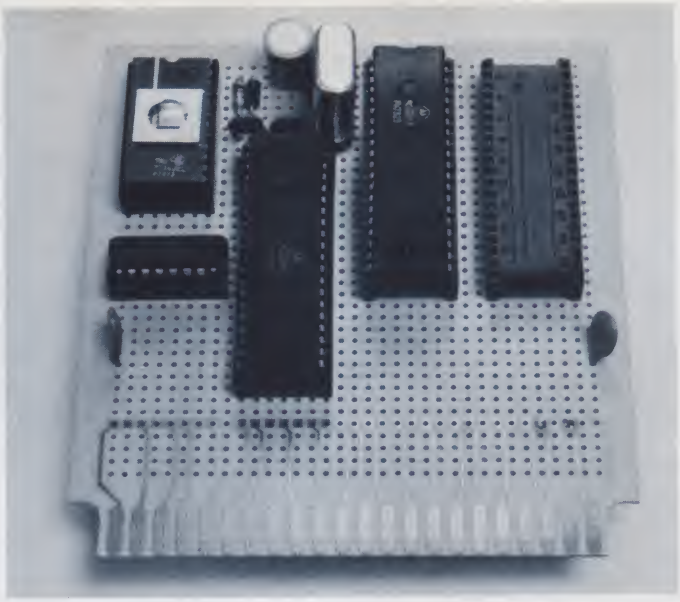


Fig. 1. Kilobaud Klassroom Komputer block diagram.



Printed circuit version. There is room for one more PIA or ACIA, as well as wire-wrap area at the bottom.



Wire-wrapped version of the computer. The two sockets at the right are wired for a PIA, but only one is installed.

also contains a built-in 128-byte RAM. Since the RAM is used just for program storage (we will put the program itself in ROM), 128 bytes of RAM is enough to run fairly complex programs.

The ROM is a 5-volt 2716 EPROM, which is manufactured by many companies under the 2716 number; the TI version is numbered TMS-2516 (the TMS-2716 is not the same part). Last year, this part was priced at $70 and more; by the beginning of 1980 it has dropped to between $25 to $30.

I/O is handled by either a 6820 or 6821 peripheral interface adapter (PIA) or a 6850 asynchronous communications interface adapter (ACIA), depending on your use for the computer. These parts currently cost about $5.

The only other IC required is a 74LS138 decoder that costs about $1. In addition, we need a 3.579 MHz color TV crystal (or any crystal in the 3-4 MHz range) and a few capacitors and resistors. The total cost for everything is under $50.

Construction is simple. The photos show two prototype computers: One is wire-wrapped on a Radio Shack circuit board (part number 276-152); the other is on a printed circuit board that also has an empty area for wire-wrapping additional circuitry. You can also build it on your experimenter's console. Although a double-sided board would be more compact, we chose a single-sided board so that you can more easily make your own.

Since the computer is designed for use as a controller, once you've finished experimenting with it, you'll be able to dedicate it to some specific purpose for the rest of its life. You can use this computer, instead of a $1000 system, to control the heating system, burglar alarm or model railroad set. It can also be used as an intelligent I/O interface between a computer and peripherals. It can perform code conversion for a Selectric typewriter, buffer a parallel graphics terminal and connect it to a serial port or act as an intelligent disk or tape controller. The possibilities are endless.

In the next installment, we'll include several programs that you can immediately use. Once you come up with your own uses, you can write your own programs.

The 6802 Microprocessor

Why did we choose the 6802? First, the 6802 is an extremely simple, direct processor to experiment with. It is extremely tolerant of bad circuit layout. There are no complex interfacing or timing specs. You can build a system on PC board, wire-wrap board or even on a prototype socket or experimenter's board, and it is still probably going to work . . . unless you make a wiring mistake.

Second, it is designed for small systems. A complete system can be built with the 6802 and Motorola's MC6846 ROM-I/O-Timer chip, which contains 2K of mask-programmed ROM, an I/O port and a timer, for a total of just two ICs. (There are several other microprocessor chips that are intended to be used all by themselves.) But these one- or two-chip systems use an internal ROM that must be mask-programmed during manufacture. This is definitely not for the experimenter or single user. For single users who can't justify a mask-programmed ROM (in quantities of 1000 or more), a separate EPROM, an

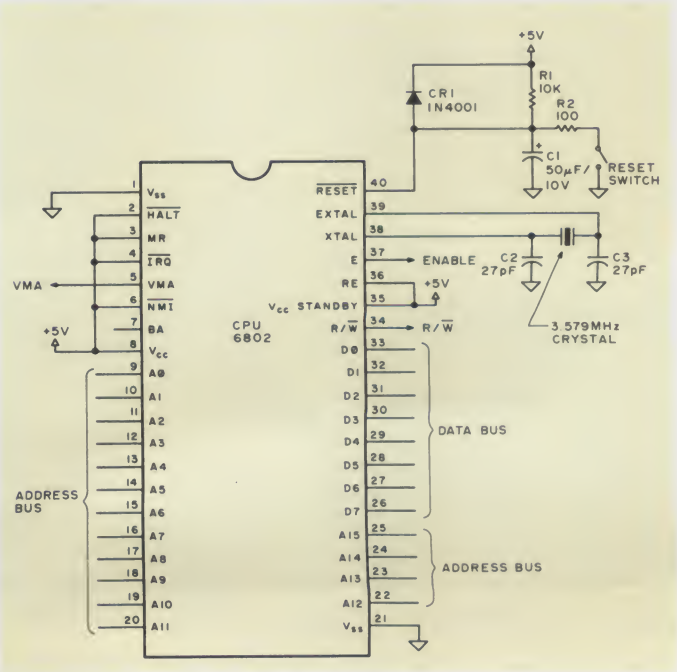


Fig. 2. 6802 CPU wiring.

I/O chip and a decoder are all you need for a four-chip 6802 system.

Third, although the 6802 involves both simple hardware and software, it is still quite versatile. It will run the same programs as a 6800. Hence, someone with a 6800 system can assemble and even debug programs for you on his system and burn EPROMs when done. Although there are other processors that can be used in two- or three-chip systems, few of them have this compatibility with existing systems. We'll use the simplicity of the 6802's software structure as a springboard for a discussion of programming in the next installment.

A final advantage is that the bus structure of the 6802 makes it easy to use with other popular chips. Most memory chips, for instance, have a read/write line, which makes them difficult to connect to an 8080, but easy to connect to a 6800 or 6802.

For instance, expanding our computer to 1K of RAM involves just two 2114 memory ICs and one gate. Also, there is a variety of I/O chips available. Besides Motorola's 6820 or 6821 parallel interface adapter, you can use their 6850 asynchronous (serial) communications interface adapter or the MOS Technology or Rockwell 6522 versatile interface module to provide both parallel and serial I/O in one IC.

Pin Layout of the 6802

Fig. 2 shows pins 1 and 21 labeled Vss, which stands for "substrate" voltage. The substrate is the silicon chip on which the rest of the circuitry is constructed; in this case, this is the ground reference for the entire IC and should be grounded.

Pin 8 is Vcc and should be at +5 volts, plus or minus 5 percent, that is, between 4.75 and 5.25 volts. However, it is a good idea to stay as close to 5 volts as possible, since some ICs (especially those from unknown sources which may be selling rejects) are sometimes voltage sensitive.

Notice that pin 35 is labeled Vcc Standby. In normal operation, this pin should also be at +5 volts. The 6802 has a built-in 128-byte RAM. The first 32 bytes (and some supporting circuitry) uses power from pin 35, while the rest of the CPU uses power from pin 8. When shutting power down, it is possible to remove power from pin 8, but use a battery to keep pin 35 at +5 volts (less than 8 mA are needed). We're not going to use this feature in our computer, but in many systems this allows data to be saved even when power is off.

Pins 9 through 25 (except for 21) are for a 16-bit address bus. These lines can drive one standard TTL load, plus as much as 90 pF capacitance.

Device Type	Input Current Needed Low (0)	High (1)	Output Drive Current Low (0)	High (1)
7400	1.6 mA	40 uA	16 mA	400 uA
74H00	2 mA	50 uA	20 mA	500 uA
74L00	.18 mA	10 uA	3.6 mA	200 uA
74LS00	.36 mA	20 uA	8 mA	400 uA
74S00	2 mA	50 uA	20 mA	1000 uA

Table 1. TTL current requirements (approximate).

Fanout

When you look at a spec sheet for a typical TTL device such as a 7400 NAND gate or 7404 inverter, you will see that the maximum input current for a TTL input is rated as 40 uA into the input for a high (1) input and 1.6 mA out of the input for a low (0) input. These current levels (40 uA and 1.6 mA) are defined as a "standard TTL load."

The same TTL device, however, can handle currents up to 400 uA or 16 mA, respectively, on the output. In other words, the output currents are ten times larger than the input currents. This means that the output of one 7400 or 7404 device can feed as many as ten other similar devices. We say that it has a fanout of 10.

But note that the address bus of the 6802 can only feed one standard TTL load; hence, it can only drive one standard TTL device. This limitation is due to the fact that, although the 6802 is TTL compatible, its output drivers are low-power MOSFET transistors rather than hefty npn transistors such as are used in 7400 TTL logic. It can therefore drive TTL ICs, but only has a fanout of one standard load.

That standard load, however, only applies to standard 7400 TTL ICs. Other forms of 74xx ICs may take more or less current. Look at Table 1 to compare other 74xx current levels. This shows that a 74L00, for instance, requires less input current than a 7400. Thus, a 7400 can drive only ten other 7400 gates, but it could drive many more 74L00 gates.

The current output capability of the 6802 address bus is listed as 1.6 mA and 145 uA. This could drive just one 7400 gate (the 1.6 mA is the real limitation), but could drive nine 74L00 gates (9 × .18 mA is 1.62 mA), or four 74LS00 gates (4 × .36 mA is 1.44 mA). We'll have to be careful what we connect to the 6802 if we want to avoid loading problems. This is the reason why in larger systems, bus drivers are required; we'll be able to avoid that if we limit the loads below the limits of one standard TTL load.

Fortunately, the MOS ICs designed to work with microprocessors require much less input current than do TTL ICs. Although the TTL low (0) level current is large and the high (1) level current is small, the MOS IC's current at a low level is almost zero, while the current at a high is at most 5 or 10 uA. Hence, the 6802 can drive one or two 74LSxx ICs and five or more MOS ICs at once.

Even if the dc current level is not exceeded, though, high currents could flow if the capacitance of the signal lines to ground were excessive. The 6802 is rated to drive up to 90 pF capacitance. Depending on the type of wire, a foot of cable could easily have 20-30 pF, and each input to an IC can have about 10 pF internal capacitance. This is a bigger problem

5V	2716-21	2716-24	6802-2	6802-3	6802-35	6802-36
	6802-4	6802-6	6802-8	74LS138-16	ACIA-10	ACIA-12
	ACIA-8	CR1-Cath	PIA1-20	PIA1-22	PIA1-24	PIA2-20
	PIA2-22	PIA2-24	R1-1			
A0	2716-8	6802-9	ACIA-11	PIA1-36	PIA2-36	
A1	2716-7	6802-10	PIA1-35	PIA2-35		
A10	2716-19	6802-19				
A13	6802-23	74LS138-1				
A14	6802-24	74LS138-2				
A15	6802-25	74LS138-3				
A2	2716-6	6802-11				
A3	2716-5	6802-12				
A4	2716-4	6802-13				
A5	2716-3	6802-14				
A6	2716-2	6802-15				
A7	2716-1	6802-16				
A8	2716-23	6802-17				
A9	2716-22	6802-18				
ACIASEL'	74LS138-11	ACIA-9				
BAUDCLOCK	ACIA-3	ACIA-4				
D0	2716-9	6802-33	ACIA-22	PIA1-33	PIA2-33	
D1	2716-10	6802-32	ACIA-21	PIA1-32	PIA2-32	
D2	2716-11	6802-31	ACIA-20	PIA1-31	PIA2-31	
D3	2716-13	6802-30	ACIA-19	PIA1-30	PIA2-30	
D4	2716-14	6802-29	ACIA-18	PIA1-29	PIA2-29	
D5	2716-15	6802-28	ACIA-17	PIA1-28	PIA2-28	
D6	2716-16	6802-27	ACIA-16	PIA1-27	PIA2-27	
D7	2716-17	6802-26	ACIA-15	PIA1-26	PIA2-26	
ENABLE	6802-37	ACIA-14	PIA1-25	PIA2-25		
GROUND	2716-12	2716-20	6802-1	6802-21	74LS138-4	
	74LS138-5	74LS138-8	ACIA-1	ACIA-23	ACIA-24	
	C1-2	C2-2	C3-2	PIA1-1	PIA2-1	RESET-SWITCH-2
PIA1SEL'	74LS138-10	PIA1-23				
PIA2SEL'	74LS138-9	PIA2-23				
R/W'	6802-34	ACIA-13	PIA1-21	PIA2-21		
RESET'	6802-40	C1-1	CR1-Anode	PIA1-34	PIA2-34	R1-2
	R2-2					
RESET-SW	R2-1	RESET-SWITCH-1				
ROMSEL'	2716-18	74LS138-7				
RXDATA	ACIA-2					
TXDATA	ACIA-6					
VMA	6802-5	74LS138-6				
XTAL1	6802-38	C2-1	CRYSTAL-1			
XTAL2	6802-39	C3-1	CRYSTAL-2			

Table 2. Complete wiring list.

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at higher speeds and also limits the total number of devices that we can drive. As a practical limit, then, an output from the 6802 (and most other processors) should not drive more than about five other devices unless you carefully figure out that a larger total load is possible.

More Pin Layouts

Pins 26 through 33 form the data bus, a bidirectional bus that can also drive one standard TTL plus 130 pF of capacitance; hence, it has more output drive capability. This bus outputs data whenever a Write to memory or I/O occurs and inputs data whenever a Read from memory or I/O occurs. The exception occurs when the 128 bytes of RAM inside the 6802 is accessed, at which time the data bus always performs an output, even when reading.

The internal RAM occupies the lowest 128 addresses, from address 0000 to address 007F (in hex). For our application we will use this RAM, but in other applications you may want to use an external (and larger) RAM in the same address space. To do this, you have to disable the internal RAM with the RE, or Ram Enable, input on pin 36. In our case, we connect this pin to +5 volts to enable the internal RAM; if it were tied to ground, then the internal RAM would be disconnected.

The R/$\overline{W}$ signal on pin 34 tells us whether the 6802 is doing a Read or Write to memory or I/O. This pin is normally high (for Read) and goes low only during writing to make sure that no accidental Writes occur in memory when not desired.

Occasionally, the processor is busy with internal operations and is not using the address or data buses. Nevertheless, there is still something on the buses during this time. To make sure that memory or I/O does not mistake this garbage for valid data

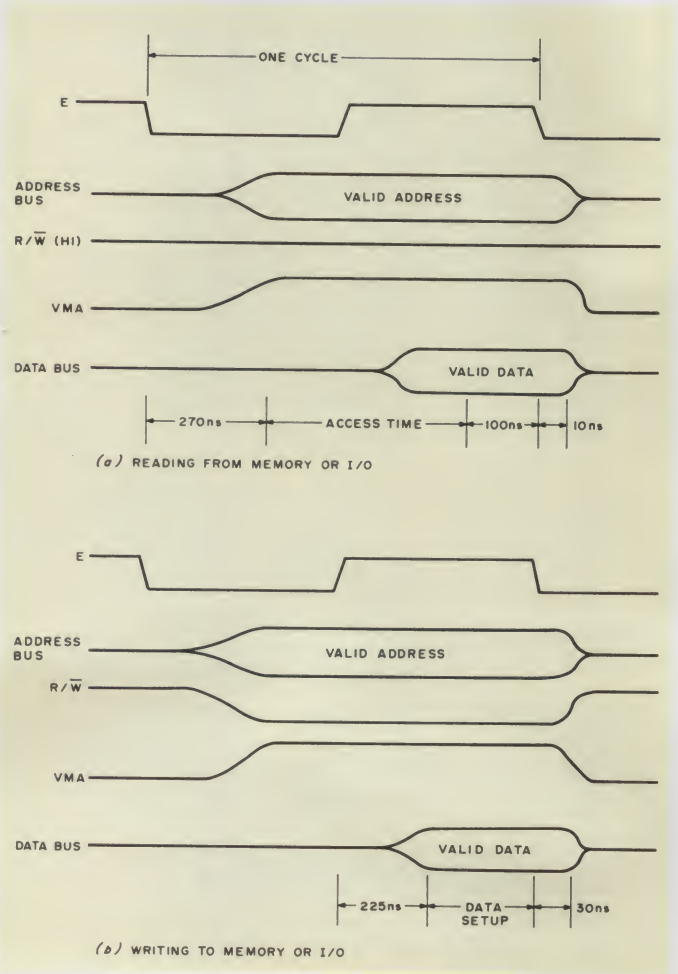


Fig. 3. 6802 processor timing diagram.

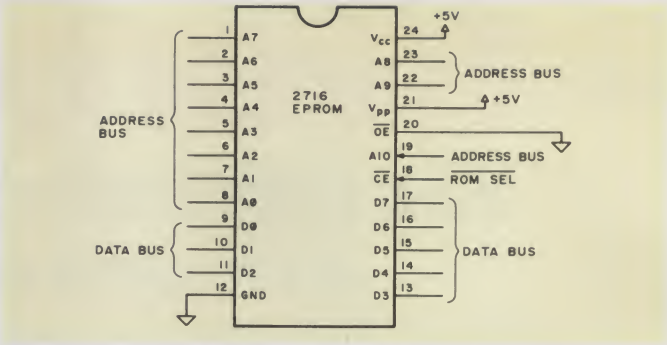


Fig. 4. 2716 EPROM wiring.

or addresses, the 6802 also outputs a valid memory address (VMA) signal on pin 5. This signal only goes high when a valid address is on the address bus and should be used along with the address in address decoding.

The reset circuit is at the top right of Fig. 2. Whenever the $\overline{RESET}$ input, pin 40, is grounded, the 6802 stops whatever it is doing, resets its internal registers and waits for the $\overline{RESET}$ to be released. As soon as $\overline{RESET}$ goes back to a high, the 6802 starts executing its program from a known beginning point.

The $\overline{RESET}$ signal must be present for a minimum of several microseconds and is not allowed to have any pulses, oscillations or switch bounce. Thus, a 50 uF capacitor is connected across the Reset switch to prevent the $\overline{RESET}$ signal from changing too fast.

The capacitor has a second job. When power is first applied, the capacitor starts out discharged to 0 volts. It eventually charges to close to +5 volts through the 10k resistor, but this takes about a half second. Whenever power first goes on there is an automatic low signal on the $\overline{RESET}$ line that makes sure the computer always starts at the right place. When power is turned off, diode CR1 discharges the capacitor rapidly, so that if the power is immediately turned back on, there will again be a reset.

Processor Timing

Unlike the 6800, which requires an externally generated two-phase clock, the 6802 has its own clock generator that only requires an external crystal to set the clock frequency.

The optimum operating speed of the 6802 is 1 MHz, but the clock circuit needs a frequency four times higher than that to generate the correct clock pulses. Hence, the crystal frequency is four times the actual clock frequency—a 4 MHz crystal would produce a 1 MHz clock.

However, a 3.579 MHz color burst crystal is a less expensive crystal used in color TV sets; it is often available for $1. Unless the resulting clock frequency of just under 900 kHz is too slow for you, this crystal is a better choice. It doesn't make much difference in computer speed—the only time a 4 MHz crystal may be more convenient is when you want to produce precise time delays by counting CPU clock cycles; the resulting clock cycle time of exactly 1 microsecond is easier to use than the 1.117 microsecond cycle time produced by the TV crystal.

Many hams have 80-meter crystals in the 3.5 to 4 MHz range that would also work, but they should be of the metal-can type rather than the older pressure-mounted type. The older crystals require too much drive current to operate reliably.

The crystal oscillator circuit inside the 6802 is connected directly to pins 38 and 39 as shown in Fig. 2. When a crystal is used in an untuned oscillator, it sometimes oscillates at a multiple of its fundamental frequency. This oscillation is prevented by C3 and C4, two 27 pF disk capacitors connected from the crystal terminals to ground. You should mount the crystal and the capacitors close to the 6802, with not more than an inch or two of wire between them.

The clock oscillator output is

divided internally in the 6802 and appears as a clock frequency of just under 900 kHz. In 6800 systems, this frequency is generated outside the 6800 and is sent to it as well as other components of the system. In a 6802 system, it is generated internally, and the clock output to other components is available on pin 37 and called E, or Enable. (If you are familiar with 6800 systems, this replaces the phase 2 clock used there.)

Fig. 3 shows the simplified timing of this E clock output in relation to a machine cycle, which is the time from one falling edge of E to the next falling edge and is 1.117 microseconds with a 3.579 MHz crystal. (This translates into 1117 nanoseconds.)

Fig. 3a shows how the data is read from memory or I/O. As the cycle begins, R/$\overline{W}$ is usually already high. Shortly after the beginning of the cycle, an address starts to appear on the address bus and, at about the same time, VMA starts going up. By 270 ns into the cycle, the address is valid and VMA is high. This is the beginning of access time.

At this point, memory or I/O devices (which are connected in the same way as memory) should start accessing the correct data so it can be put on the data bus. The data usually appears after the Enable signal goes back high. In any case, it must be there at least 100 ns before the Enable signal falls and must stay there at least 10 more ns after that.

Thus, access time is counted from the time memory gets an address and VMA signal to the time data absolutely must be on the data bus. We can figure out the actual access time simply by subtracting 270 and 100 ns from the 1117 ns total time:

1117 – 270 – 100 = 747 ns.

If we add more memory to the system, however, we may have to add some gating and address decoding as well. The time that this takes must then be subtracted too. If we assume that all this extra circuitry will take roughly another 100 ns, then that leaves about 650 ns for the memory itself. Thus, a 650-nanosecond access time 2716 is fast enough, and we need not buy faster ones. Likewise, any other ROMs or RAMs used to expand the computer need only be 650 ns types.

However, if we go to a 4 MHz crystal, the cycle time drops from 1117 ns to 1000 ns, and so the access time must also go down by 117 ns to about 530 ns. Hence, increasing the CPU speed might require use of faster memory.

Fig. 3b shows what happens when data is written out to memory or I/O. Address bus and VMA operation is the same, except that R/$\overline{W}$ also goes low to indicate that a Write is occurring instead of a Read. This time the data on the data bus will come from the 6802 between 165 and 225 ns after E goes high and stays there at least 30 ns after E goes low again. Since the E signal is high for half of a cycle, or about 560 ns, the so-called data set-up time is:

560 – 225 = 335 ns.

This difference shows the time allowed external memory or I/O devices to grab the data off the bus.

Let's explain the reason for the E signal. Data is always present on the bus when E goes low at the end of a cycle. Hence, all devices on the bus should use the falling edge of E to clock in the data. In our system, we will feed the E signal to our parallel or serial interface chips. The ROM doesn't need it since it never inputs data, but if we connected more RAM we'd have to feed E there too.

6802 Processor Control

Most of the processor control signals shown in the top-left corner of Fig. 2 are tied high to +5 volts in our system. Pin 2 is the $\overline{HALT}$ input. Whenever $\overline{HALT}$ is grounded, the 6802 will finish its current instruction and simply wait until $\overline{HALT}$ is brought high again.

Pin 3 is a Memory Ready signal used with slow memory. If MR is brought low just after the E signal goes high (during the second half of a cycle), then E will stay high as long as MR is low. This could be used to stretch E to give more time to slow memory or I/O devices to complete reading or writing. You must be careful because if the E signal is stretched more than 9.5 microseconds, the 6802 will start to forget what it was doing when it was halted. This is because its internal circuitry is dynamic (remember dynamic memory?) and requires the clock to refresh it before it forgets.

Pins 4 and 6 are the interrupt inputs. In our simple computer we won't use interrupts and will always keep these inputs high at +5 volts. If one of them is grounded, it will cause an interrupt to occur. See Kilobaud Klassroom No. 16 (February 1979, p. 32) for a further discussion.

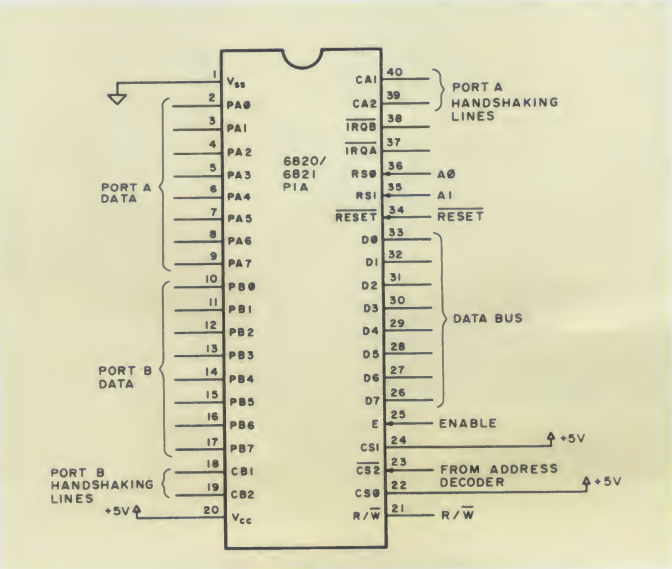


Fig. 5. PIA wiring.

Pin 7 is an output that stands for bus available (BA). Whenever a halt occurs (by grounding the $\overline{HALT}$ line) or whenever the 6802 encounters a WAIT instruction as part of a program, it open-circuits its three-state outputs on the data bus and stops using the address bus (although the address bus outputs are not three-state devices). To signal that these buses could now be used by an external device, the 6802 makes the BA signal go high. This would be useful if we were using DMA (direct memory access) input/output, or if we had another 6802 on the same bus sharing memory. In our case, though, we will not use BA.

2716 ROM Operation

The 2716 EPROM is a 24-pin IC whose pin layout is shown in Fig. 4. It is a 2K × 8 ROM; it has 2K, or 2048, memory locations, each with eight bits. This is enough to store a sizable program.

Connections to the 2716 are fairly simple. In addition to power and ground, we connect the data bus to the D0 through D7 pins and the least significant eleven bits of the address bus to the A0 through A10 pins. Eleven address lines allow us to select 2^{11}, or 2048, locations.

The data outputs of the 2716 are three-state outputs, and data comes out of the ROM only when both $\overline{CE}$ and $\overline{OE}$ are low. $\overline{CE}$ is a Chip Enable signal,while $\overline{OE}$ is an Output Enable. If $\overline{OE}$ alone is low, then the ROM is enabled and working, but the three-state output drivers are in their open state and so the data cannot get to the data bus.

On the other hand, when $\overline{CE}$ is low, the chip is disabled and the outputs are also off. Hence, in our simple system we can just ground the $\overline{OE}$ and let $\overline{CE}$ do all the work. When $\overline{CE}$ is high, the 2716 is also in a standby mode, where it takes less power from the supply. In our case, this is not significant, since the program in the ROM will run continuously, but it does reduce the power. (The computer, with one PIA, uses just under 250 mA from its +5-volt supply when running.)

Vpp is an extra power input

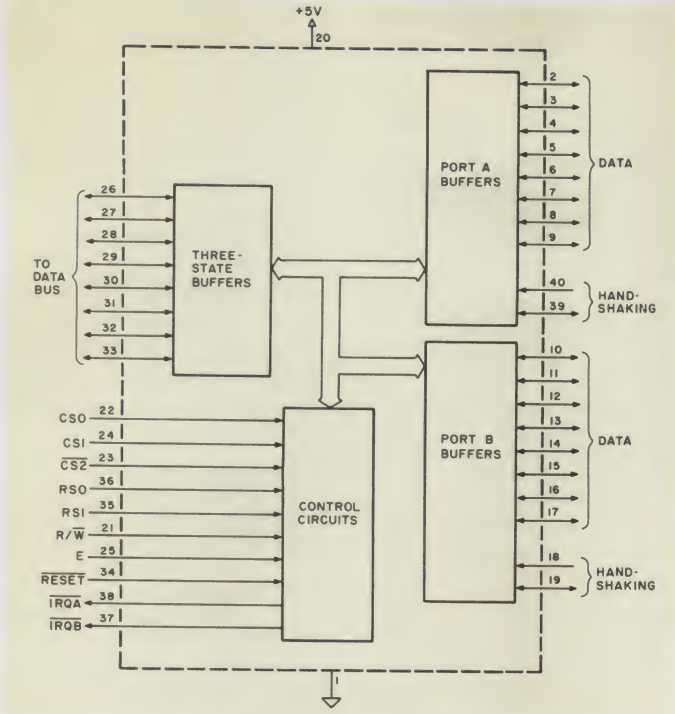


Fig. 6. PIA block diagram.

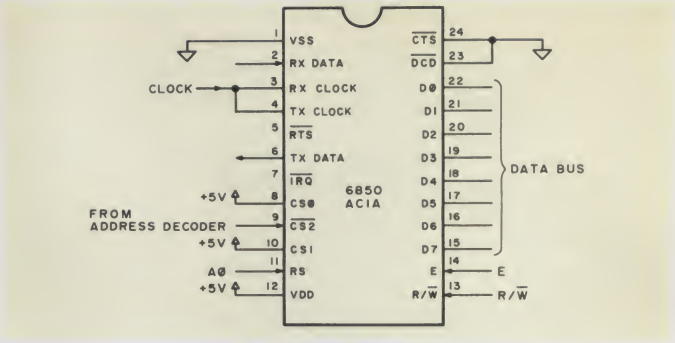


Fig. 7. ACIA wiring.

pin used during programming of the EPROM. During programming, the 2716 requires +25 volts on the Vpp pin; during normal operation it requires +5 volts.

The $\overline{CE}$ signal comes from an address decoder that uses the 74LS138, but address decoding can also be done in other ways, which we'll discuss later.

In normal operation, the 2716 gets an address and a $\overline{CE}$ signal and then simply outputs data after some access time. Different manufacturers rate their access times differently, but here are access times for several versions of the Intel 2716:

2716 is 450 ns access time
2716-1 is 350 ns access time
2716-2 is 390 ns access time

All of these would work well in our circuit; the slower versions are cheaper, and most of the Intel units available from *Kilobaud* advertisers are the 450 ns type.

The 6820/6821 PIA

The PIA is a peripheral interface adapter designed to provide two parallel input or output ports for 6800/6802 systems. The current version is the 6821; the earlier version was the 6820. Both of these are identical to the 6520 PIA manufactured by MOS Technology for use with the 6502 processor.

Fig. 5 shows the pinout of the PIA and its connections to the rest of the system; Fig. 6 shows a block diagram of the PIA. Basically, the PIA has two I/O ports: port A and port B. Either one of these can be used for input or output, and both have a pair of additional lines that can be used for handshaking.

Interfacing to the 6802 is handled through the data bus shown in the top left of Fig. 6 and through the control lines shown just below.

The control lines are fairly obvious. The E (Enable), R/$\overline{W}$ and and $\overline{RESET}$ lines connect to the same points on the 6802. $\overline{IRQA}$ and $\overline{IRQB}$ are two interrupt request outputs that we don't use. RS0 and RS1 are register select inputs that select which internal register of the PIA the 6802 is accessing during programming and simply connect to the A0 and A1 address lines, respectively. Their function will become obvious when we discuss PIA programming.

The CS0, CS1 and $\overline{CS2}$ lines are used as chip selects. In order for the 6802 to access the PIA, CS0 and CS1 must be high and $\overline{CS2}$ must be low. In our circuit, CS0 and CS1 are connected to +5 volts and therefore always high. $\overline{CS2}$ is driven by the address decoder. Whenever the 6802 accesses the PIA, $\overline{CS2}$ will get a low pulse from the decoder, which will complete the chip select requirements.

The 6850 ACIA

The 6850 asynchronous communications interface adapter is used for serial input and output. In most applications of our Kilobaud Klassroom Komputer, we won't need a serial I/O port for communicating with a teleprinter or CRT terminal, but there may be some cases where you do.

Fig. 7 shows the pinout of the ACIA and its connections to the rest of the computer; Fig. 8 shows its block diagram.

The ACIA has a transmitter data register, which takes parallel data received from the data bus and converts it to serial for transmission to a teleprinter or terminal; the receiver data register does the opposite for serial data received. Both of these require a baud rate clock signal, which is called RXCLK and TXCLK in the IC documentation. This is a square wave signal

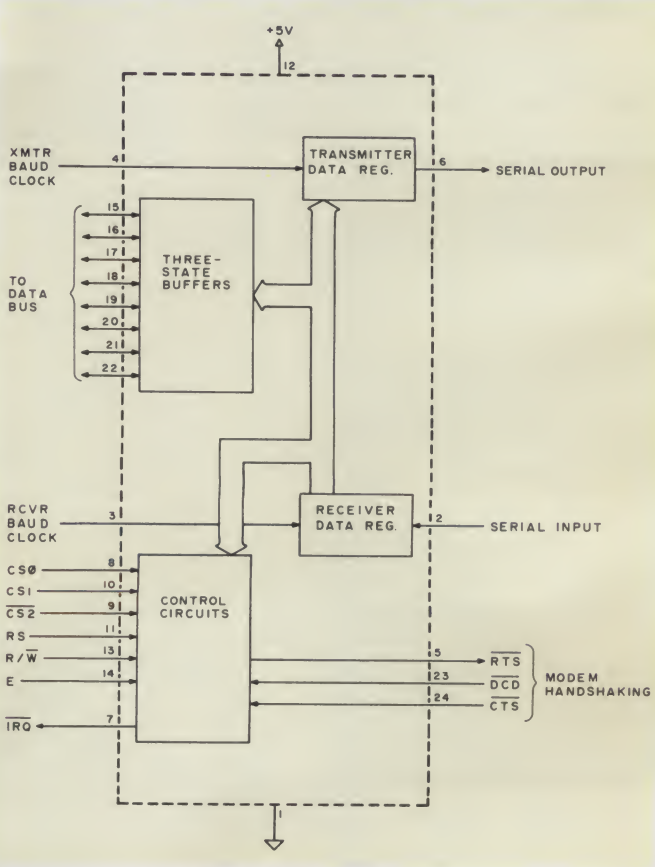


Fig. 8. ACIA block diagram.

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whose frequency can be 64 times the baud rate, 16 times the baud rate or equal to the baud rate, depending on ACIA programming. The 16 × rate is usually used to make it similar to a UART.

On the 6802 side, the ACIA connects via three CS chip selects similar to those of the PIA: an RS register select pin that connects to address bit A0 and is used during programming, and the R/$\overline{W}$ and Enable signals, which connect directly to the 6802. The $\overline{IRQ}$ pin is not used.

Address Decoding

The 128 bytes of RAM inside the 6802 are controlled by an address decoder that is also inside the 6802. It occupies hex addresses 0000 through 007F. This RAM is fully address decoded, which means that it occupies those and only those addresses.

The 2716 ROM must be addressed so that it includes addresses FFFE and FFFF, which are used by 6800 and 6802 processors to fetch the starting address of the program to execute when a Reset is done. Since the 2716 contains 2K bytes of ROM, it should therefore contain addresses F800 through FFFF.

Now comes an important consideration. Although we could fully decode the ROM addresses to include F800–FFFF, and only those addresses, there is really no need to in a simple system such as this one. The 6802 has 64K addresses available.

Since we'll never expand this computer to anywhere near this number, we can afford to throw away addresses. If the ROM address decoding is done incompletely, so that the ROM takes up not just the necessary 2K of addresses, but perhaps another 2K, 4K or even more, it really doesn't make much difference. In the process, we can make the decoding circuitry simpler.

On the other hand, we must make sure that it doesn't use up so many addresses that we have none left for the PIA and ACIA, or for a few additions we may dream up in the future.

Fig. 9 shows the resulting decoding circuit, which uses one 74LS138 decoder to decode the three most significant bits of the address.

The 74LS138 decoder is specifically designed for high speed and has a propagation delay (the delay time from the time an input arrives until it provides an output) of about 20 nanoseconds. It's important to minimize propagation delay in address decoders, since the time they take is subtracted from the access time available for memory or I/O devices. Twenty ns delay is not significant in our system.

The 74LS138 is a popular address decoder IC because it has three chip-select inputs called G1, G2 and G3; in our case, only one of those is needed. In order for the decoder to work, G1 must be high while G2 and G3 are both low. We simply ground G2 and G3 permanently to keep them low and connect G1 to the valid memory address (VMA) output of the 6802. Thus, the decoder is only enabled when the processor is sending out an actual memory address.

The three most significant address bits, A15 through A13, connect to the C, B and A inputs of the decoder. The 74LS138 has eight outputs, labeled 0 through 7, which correspond to the eight

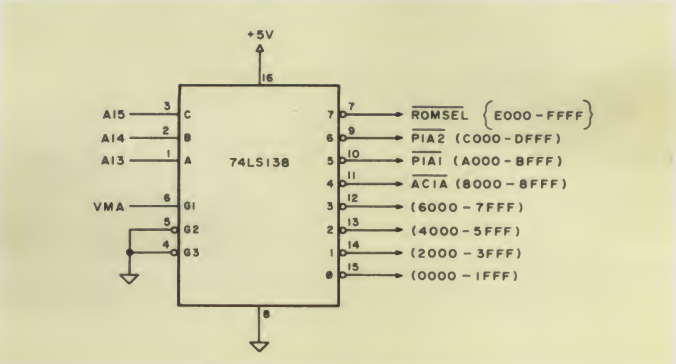


Fig. 9. Address decoding.

possible input combinations on the C, B and A inputs. When the decoder is not enabled, all of these outputs are high (2.4 volts or more). When the IC is selected, then one of those outputs will go low (near ground); which output goes low depends on the binary number coming in on the CBA inputs. If the input is a decimal 0, a binary 000, then the number 0 output goes low, and so on.

In our case, the output from the decoder then depends on the three most significant bits on the address bus. For addresses starting with 111 (which includes hex addresses E000 through FFFF), the number 7 output goes low. This output is the $\overline{\text{ROMSEL}}$ signal, which goes to the $\overline{\text{CE}}$ input of the 2716 EPROM. Thus, the 2716 occupies addresses E000-FFFF. The EPROM uses up 8K of addresses, although only 2K is needed.

There are four "copies" of the ROM contents in that 8K; one occupies the 2K from E000-E7FF, the second occupies the 2K from E800-EFFF, the third occupies addresses F000-F7FF and the fourth occupies F800-FFFF. We could address the ROM at any one of these four regions, and will simply continue to use the F800-FFFF address range as though the others didn't exist.

The 74LS138 decoder has seven more outputs, each of which decodes an 8K region of memory as shown in Fig. 9.

Although the basic computer only requires decoding for the ROM and one PIA, the printed circuit board layout has room for a second PIA or for an ACIA. Moreover, the board has a wire-wrap area that can accommodate more I/O circuitry or memory. Thus, the address decoder is designed to provide decoding for eight different address ranges of 8K each. For example, the number 5 output from pin 10 becomes the select signal for PIA1, which occupies addresses A000-BFFF.

Construction

Construction of the computer is not critical; wire-wrapping, solder-wrapping and many other breadboarding techniques will work well.

Alternatively, you may use the printed circuit board layout of Fig. 10. This is a 6 x 6 inch single-sided board that is fairly easy to reproduce by most photographic methods. (If you prefer to get a ready-made board, etched and drilled boards and other components are available from Star-Kits, PO Box 209, Mt. Kisco NY 10549.)

Fig. 11 shows the parts layout. The PC board has room for the 2716 EPROM, the 6802 microprocessor, the 74LS138 address decoder, a 6820 (or 6821 or 6520) PIA and either a second PIA or a 6850 ACIA. In the upper-left corner is also a spot for a 7805 three-terminal 5-volt regulator. The bottom area has space for either soldered connections or for Molex 09-52-3122 connectors (the same type used on the SWTP and Heath H8).

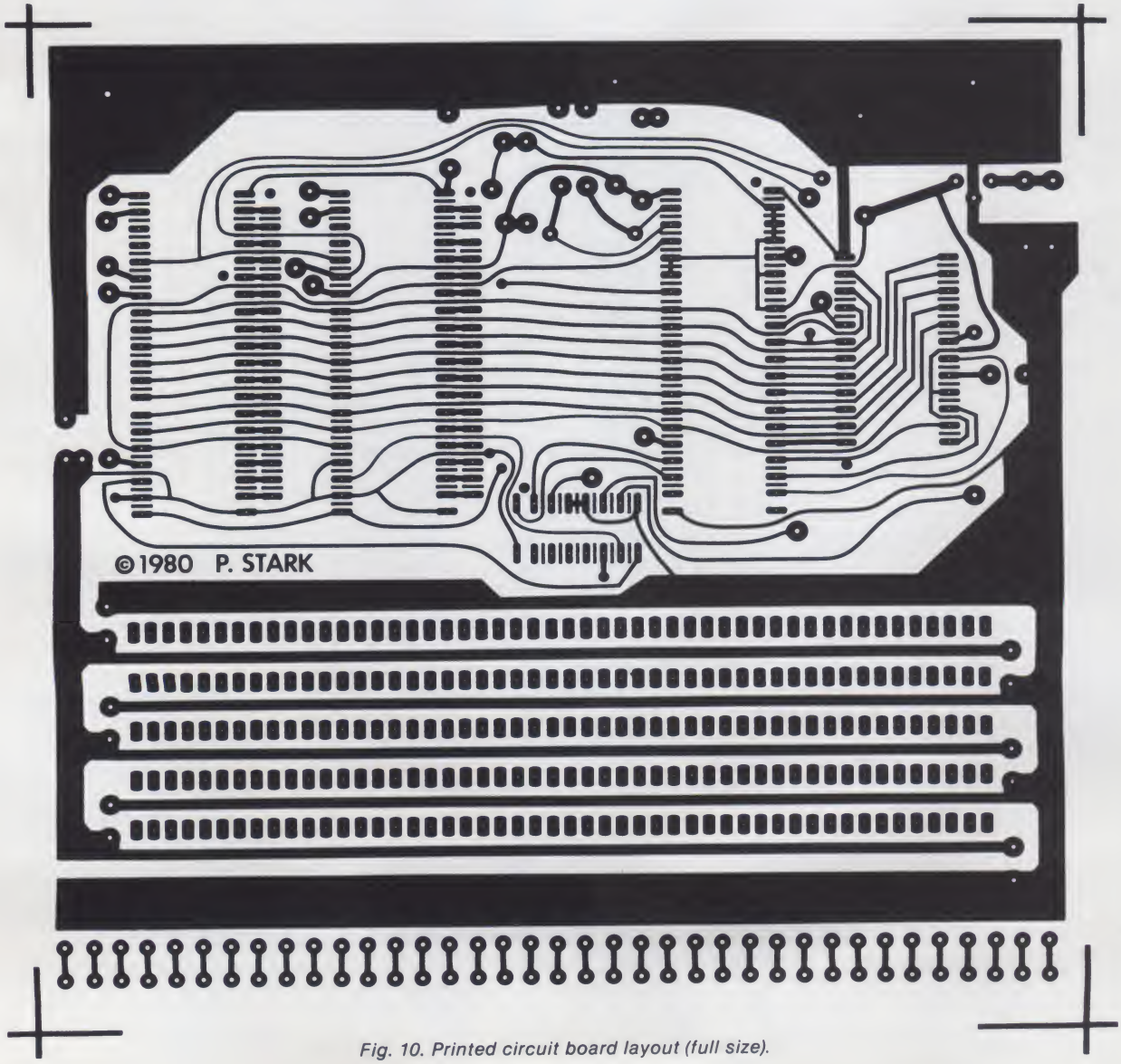


Fig. 10. Printed circuit board layout (full size).

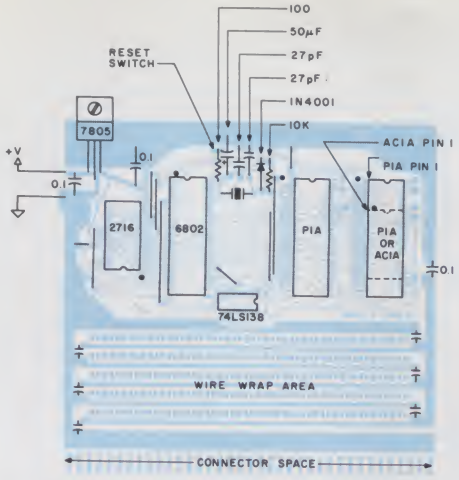


Fig. 11. Parts layout on printed circuit board.

Just above that is a wire-wrap area that can accommodate roughly ten small IC sockets or several large ones. This area can be used for more memory or I/O, or for interfaces (such as level converters, drivers or optocouplers) to external equipment.

The IC position in the top-right corner can be used for either a PIA or an ACIA. Although the PIA has 40 pins and the ACIA only 24, some signals on the two ICs are in the same relative positions. If the ACIA is inserted so that its pin 1 is in the position normally occupied by the PIA's pin 6, then many of the ACIA connections will match those required for the PIA. The remaining connections (ACIA pins 1-13, 23 and 24, or PIA pins 24, 34 and 35) that overlap between the two ICs will have to be made by hand.

Only those PIA or ACIA connections that go to the 6802 are etched on the PC board; each of the other pins (which would normally go to the outside world) is brought to a connection pad to which we can solder a wire. These connections vary, depending on your specific application.

If you decide to wire-wrap the computer or to build it in some other way, use the wiring list of Table 2. Every required connection is listed in this table next to the signal name. This list includes wiring for two PIAs (called PIA1 and PIA2), as well as an ACIA; simply omit connections to those devices you don't need.

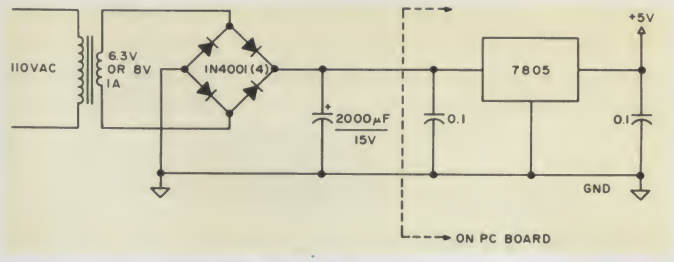


Fig. 12. Power supply.

If you do not use an ACIA, also omit the signals called ACIASEL, BAUDCLOCK, RXDATA and TXDATA, which are, respectively, the address decoder output for the ACIA, the clock signal that sets the ACIA baud rate and the received and transmitted serial data. We'll show how to use these in the next installment.

Table 2 will also help you complete the PIA2 or ACIA connections to the top-right socket in the printed circuit board.

Power Supply

The completed computer with one PIA takes just under 250 mA from a +5-volt power supply. Fig. 12 shows the suggested circuit for a suitable supply.

The power transformer should provide at least 6.3 volts (preferably 8 volts) ac to the bridge rectifier. Although a 1 Amp transformer is more than sufficient, a 3 Amp unit will run cooler. From past experience, I have noticed that some of the small 500 mA or 1 Amp transformers drop below 6.3 volts when loaded. If this happens, then the voltage to the regulator will not be high enough for proper operation.

A 2000 uF filter capacitor should be enough for the computer and a few additional ICs. If you use a 6.3-volt transformer or add a lot of circuitry to the computer, then 4000 uF would be preferable along with heavier diodes than the 1N4001 units specified.

Two 0.1 uF disk capacitors are shown in Fig. 12—one before the regulator and one after. Actually, the board has room for eight 0.1 uF capacitors on the output side of the regulator. Two of these (which are labeled in the board layout of Fig. 11) should always be installed. The other six (which are in the wire-wrap area and not labeled on Fig. 11) are only required if you add components to the wire-wrap area.

Next time we'll continue with troubleshooting information and start with some programming examples to show how to use our new computer.■

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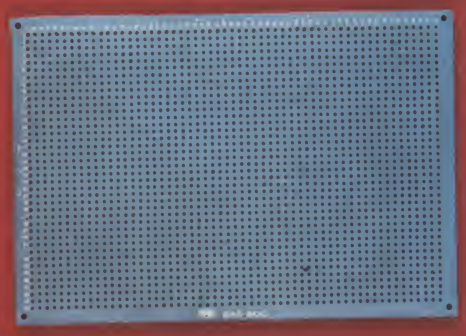
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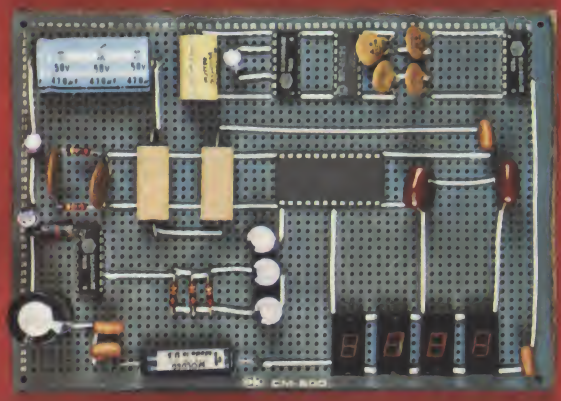
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A File Sorting Program And Its Diary

A diary kept during the writing of an Apple II file sorting program resulted in this article.

Al Prentice
PO Box 2998
Escondido CA 92025

A while back I decided that I needed a file sorting program for my Apple II and its disk. As I began to think about writing the program, it occurred to me that many of the Apple owners I know seem to be confused about using the Apple disk operating system. I have worked with large-scale systems, on the software side, for over 22 years and am pleased with this disk operating system. It has several important and useful features, and I hope that others are as happy with it as I am.

As a result, I decided to keep a rough diary as I wrote the file sort program. This article is the result of that decision, and I hope that the readers will find something useful in it to help them use their Apple DOS more easily.

In this first part of the two-part article, we'll consider the best strategies for attacking this complex programming task. With the planning complete, we'll write the "top level" or "main" program, then learn about opening and closing Apple DOS files as we write the first two subroutines.

a.

```
<50                  > LEN=20
<8                   > LEN=20
<3                   > LEN=20
<NAME                > LEN=20
<ADDRESS             > LEN=20
<PROFESSION          > LEN=20
<BLOW JOE            > LEN=20
<CHICAGO             > LEN=20
<WINDBAG     CLASS 1A> LEN=20
<NIMBLE JACK B.      > LEN=20
<CANDLESTICK PARK    > LEN=20
<HIGH JUMPER CLASS 1B> LEN=20
<CINDERELLA          > LEN=20
<SHANTYTOWN          > LEN=20
<GOLDIGGER   CLASS 4A> LEN=20
<KENT CLARK          > LEN=20
<METROPOLIS          > LEN=20
<STRONG ARM  CLASS 3A> LEN=20
<BULLWINKLE GEN.     > LEN=20
<NORTH WOODS         > LEN=20
<COMPANION   CLASS 2A> LEN=20
<CROWLEY ALEISTER    > LEN=20
<HIGHER PLANES       > LEN=20
<MAGICIAN    CLASS 1A> LEN=20
```

b.

```
<50> LEN=2
<8> LEN=1
<3> LEN=1
<NAME> LEN=4
<ADDRESS> LEN=7
<PROFESSION> LEN=10
<BLOW JOE> LEN=8
<CHICAGO> LEN=7
<WINDBAG     CLASS 1A> LEN=20
<NIMBLE JACK B.> LEN=14
<CANDLESTICK PARK> LEN=16
<HIGH JUMPER CLASS 1B> LEN=20
<CINDERELLA> LEN=10
<SHANTYTOWN> LEN=10
<GOLDIGGER   CLASS 4A> LEN=20
<KENT CLARK> LEN=10
<METROPOLIS> LEN=10
<STRONG ARM  CLASS 3A> LEN=20
<BULLWINKLE GEN.> LEN=15
<NORTH WOODS> LEN=11
<COMPANION   CLASS 2A> LEN=20
<CROWLEY ALEISTER> LEN=16
<HIGHER PLANES> LEN=13
<MAGICIAN    CLASS 1A> LEN=20
```

Fig. 1. Examples of a fixed-record-length file (a) and a variable-record-length file (b). The files were printed by a program that prints the contents of each record between the less than and greater than symbols and follows the record with its length in characters.

File Formats

The first set of issues encountered in designing the file sort program arose out of the question: "What kinds of files will this program be able to sort?" The first decision I made was to limit its capabilities to fixed-record-length files. Fixed-record-length files, which are supported by Apple DOS, are files in which all records are exactly the same length. Figs. 1a and 1b show the same data written first as fixed-record-length and as variable-record-length files. As things turned out, the program can quite easily be modified to sort variable-record-length files too, but I'll talk more about that later.

The second decision I made was that the program should be able to sort files composed of record groups and should sort groups, not records. Record groups are simply sets of consecutive records that must stay grouped together during the sorting process. For example, consider the file shown in Fig. 1a (ignoring, for a moment, the first six records). It is a fixed-record-length file of information about people in which each record has 20 data characters, but there are three such records for each person. Thus, that file has record groups containing three records in each group. I wanted a program that would sort the record groups, *not* the individual records!

Finally, I decided that I wanted a program that would sort on variable-length keys and allow the user to specify their location and length. In the terminology of sort programs, a "key" is that portion of a record (or, in our case, a record group) that is compared during the sort. The remainder of the record or the record group is ignored during the sorting process. Again drawing an example from the file shown in Fig. 1a, I wanted to be able to sort the file on the people's names or on their professions or on their "grade" (e.g., class 1A, etc.).

Putting all of these decisions together, I decided that I wanted a file sort program that would sort a file of record groups (although each group might have only one record) on variable-length keys whose length and location I could input when I ran the program. I also decided that a key would not stretch across two or more records in a group. As a result, I drew a sketch showing the kinds of files my program would be able to sort. A version of the sketch appears as Fig. 2.

File Sort Program

Assumptions:

1. fixed-record-length files only
2. all keys can be contained in memory—at one time

Inputs:

1. OF$ the name of the file to be sorted
2. SF$ the name of the resulting sorted file
3. RL the length of all records (see assumption 1) in the file OF$
4. RG the number of records in a record group (files which don't have record groups are treated as though they have one record to a group)
5. KR the record number of the record within the group which contains the key
6. KF the character within the KRth record which is the first character of the key field
7. KL the length in characters of the key field
8. HS the length, in records, of the header on the file
9. EF$ the end-of-file string, i.e., the special string of characters which signals the end of the data to be sorted.

Important Variables:

1. IX(n) an array of record-group numbers, which show the position of the record groups in the unsorted file
2. KY$(n) the keys which were extracted from the file OF$
3. K a counter containing the number of record groups (and thus keys) which were read from file OF$

Example 1. Program specification.

Top Level Specification of the Program

I now moved on to the next step in the design of the program. I like to write a brief top level specification of the more important aspects of a program before proceeding with the design or programming of it. I have found that, even for a relatively simple program, I use that specification almost constantly during my following work. It is short, contains the information I most frequently need and is easier to refer to than the program itself.

The specification that I wrote is in Example 1. As you might have guessed from reading the specification, I thought of a few more things as I wrote the specification. I always do! And that's another good reason for writing the specification. In particular, I realized that the program would have to have some way of knowing when, while reading the file OF$, it had reached the end of the data to be sorted, and so I added input item 9.

Another issue that occurred to me as I was writing the specification was that some files might have a header. A header is a set of records (the same size as the other records in the file) that precedes the data to be sorted. The first six records of the file shown in Fig. 1a comprise a header that contains data which describes the rest of the file. Ignoring a few records at the front of a file seemed a simple thing to do, so I decided to add the feature of handling files with headers and included input item 8.

When I turned my attention to the subject of "important variables," I adopted a common sorting strategy wherein the only information used during the sorting process would be the keys and their original locations in the input file (OF$). My program could perform the sort by rearranging the keys (KY$) and the numbers which showed their original position, and then use the result as a sort index for the input file. For example, consider the following input file keys in the order:

```
DOG
ABLE
CHARLIE
BAKER
```

The program would read in the keys and record their original position as follows:

n	IX(n)	KY$(n)
1	1	DOG
2	2	ABLE
3	3	CHARLIE
4	4	BAKER

After sorting the keys and rearranging the index accordingly, we would get:

n	IX(n)	KY$(n)
1	2	ABLE
2	4	BAKER
3	3	CHARLIE
4	1	DOG

The sort index, stored in the array IX, will tell us the order in which to read the record groups if we want them in alphabetic sequence (in this case, 2, 4, 3 and 1).

The specification also shows that I planned to use an important and useful feature of Apple DOS. Apple DOS provides a way for a program to read in the name of a file and then use that file name for various file operations. We will examine this feature in more detail later in this article.

The Top Level Program

The next step in the development of the file sort program is to write the top level of the program and check it out. I started by writing a brief sketch of the program before I began programming. In this case, the sketch was quite simple:

- get the sorting instructions from the user
- set up the parameters for extracting KY$ and IX from the input file OF$
- extract the key fields and record their original positions
- sort the KY$(n) and the IX(n) on KY$(n)
- read the original file using the IX(n) sequence and write out the sorted file
- wrap up and end

This sketch serves essentially the same purpose for a programmer that an outline does for a writer. I now turned to my keyboard and started composing the program.

The Apple II has not one but two BASIC programming systems, which are called Integer BASIC and Applesoft II. Whenever it is reasonable, I choose to program in Integer BASIC, which, to my mind, is a much superior system. I favor it for many reasons, but among the most important is that it performs diagnostics as each line is entered. Therefore, it will not allow a syntactically incorrect statement to be entered. In other words, if Integer BASIC can determine that a statement is incorrect, it won't let you enter it. This one feature saves you a great deal of programming time.

However, Applesoft II has its strong points too. It is, essentially, Microsoft BASIC that has been enhanced by some special language additions to support the special features of the Apple II. I chose Applesoft II for the file sort program because it provides for arrays of strings. The file sort program would, as will be seen later, need to index through an array of keys and, therefore, I knew that it would

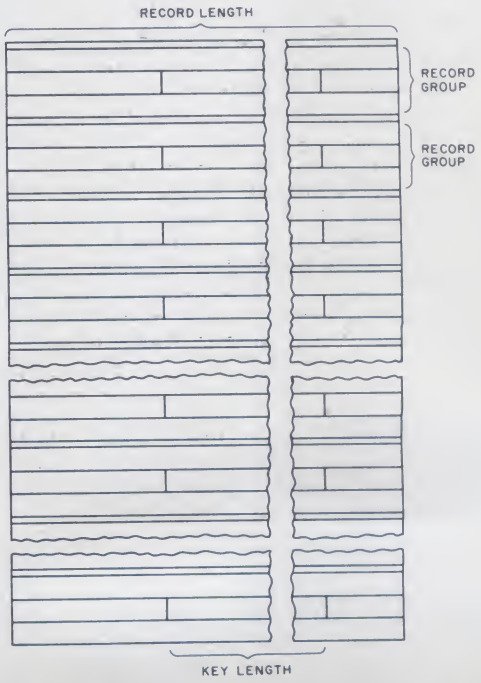


Fig. 2. The basic organization of the kinds of files that can be sorted is record groups of fixed length records. The sort key may be contained anywhere within a record. Although the figure shows record groups of three records, the number is allowed to vary from file to file.

a.

```
0  REM  FILE SORT V0
1  REM  NOV. 19, 1978
2  REM  BY AL PRENTICE
10  DIM KY$(700),IX(700)
400  REM  GET SORTING INSTRUC-   TIONS FROM THE USER.
410  GOSUB 5000
420  REM  SET UP PARAMETERS FOR  EXTRACTING KY$(N) AND IX(N).
430  GOSUB 6000
500  REM  EXTRACT KEY FIELDS,    KY$(N), AND ORIGINAL RECORD GROUP NUMBER
     S, IX(N).
510  GOSUB 2000
520  REM  SORT KY$(N) AND IX(N)  ON KY$(N).
530  GOSUB 1000
540  REM  WRITE THE SORT INDEX   FILE OUT
550  GOSUB 3000
560  REM  WRAP UP AND END
570  GOSUB 4000
580  END
1000  PRINT "AT ROUTINE 1000": RETURN
2000  PRINT "AT ROUTINE 2000": RETURN
3000  PRINT "AT ROUTINE 3000": RETURN
4000  PRINT "AT ROUTINE 4000": RETURN
5000  PRINT "AT ROUTINE 5000": RETURN
```

b.

```
]RUN
AT ROUTINE 5000

?UNDEF'D STATEMENT ERROR IN 430
]LIST 430

430  GOSUB 6000


]6000 PRINT "AT ROUTINE 6000":RETURN
```

c.

```
]RUN
AT ROUTINE 5000
AT ROUTINE 6000
AT ROUTINE 2000
AT ROUTINE 1000
AT ROUTINE 3000
AT ROUTINE 4000
```

Fig. 3. The top level program and its stubs (a). The first debugging run (b) shows that I neglected to write the code for the stub at line 6000. The stub was added, and the correct results were obtained (c).

be much easier to program in Applesoft II.

Writing the top level program went quite smoothly. I wrote a program that would call a subroutine for each of the steps shown in the sketch of the program (see Fig. 3a). All of the rest of the file sort program would be somewhere inside one of those subroutines called by this top level program. Thus everything else is at a lower level, and that's where the top level program gets its name.

This strategy is what is popularly called top-down implementation of a program. It is possible to write an entire program from the top down through the bottom and then to debug it upwards from the bottom by debugging the lowest level subroutines first. There are several popular strategies, each of which has its advantages and disadvantages. However, when using a personal computer, I almost always use the top-down programming and top-down debugging strategies.

When doing so we must provide dummy subroutines, which, in the jargon of today, are called stubs. Dummy routines, or stubs, are just do-nothing routines that fill in the holes while we debug higher level routines. The stubs for checking out the file-sort top level program appear as lines 1000 to 5000 in Fig. 3a.

It is a good practice to make your stubs a little more than do-nothings (i.e., just a RETURN statement). At the very least they should print out some unique identifying information as we have done here. Sometimes you will need more complicated stubs in order to fully check out the higher level routine, but in this case the print/return variety was sufficient.

The first execution of the top level program produced the result shown in Fig. 3b. Examination of statement 430 revealed that I had forgotten to provide the stub for the routine at line 6000. The stub for line 6000, as shown in Fig. 3b, was added, and the results of the next test are shown in Fig. 3c. Those were the correct results for the simple top level program, and I considered it to be debugged and moved on to program the lower level subroutines.

Getting the Sorting Instructions from the User

The first of the subroutines I chose to program was the routine at line 5000. This was the

```
5000  REM  ----------------------
5010  REM  GET THE SORING INSTR-  UCTIONS FROM THE USER.
5020  REM  ----------------------
5100  PRINT "WHAT IS THE NAME OF THE FILE TO BE"
5101  INPUT "SORTED? ";OF$
5120  PRINT "WHAT IS TO BE THE NAME OF THE SORTED"
5121  INPUT "FILE? ";SF$
5130  PRINT : PRINT "THE INPUT FILE MUST BE A FIXED RECORD": PRINT "LENGT
     H FILE.": PRINT
5140  PRINT "WHAT IS THE LENGTH, IN CHARACTERS, OF": INPUT "THE RECORDS (
     EXCLUDING THE FINAL <CR>)? ";RL
5150  PRINT : PRINT "RECORDS IN THE INPUT FILE ARE CONSIDERED": PRINT "TO
      BE GROUPED INTO WHAT WE CALL RECORD"
5160  PRINT "GROUPS.  IF YOUR FILE IS NOT ORGANIZED": PRINT "AS GROUPS TH
     E NUMBER OF RECORDS IN A": PRINT "GROUP IS SAID TO BE 1": PRINT
5170  PRINT "HOW MANY RECORDS ARE IN A RECORD GROUP": INPUT "IN THE INPUT
      FILE? ";RG
5171  GOSUB 12000: GOTO 5190
5180  PRINT : PRINT "THE 'KEY FIELD' IS THE STRING OF CHAR-": PRINT "ACTE
     RS WITHIN EACH RECORD GROUP WHICH": PRINT "WILL BE USED TO SORT THE
      RECORDS."
5185  PRINT "THE KEY FIELD MUST BE CONTAINED WITHIN": PRINT "A SINGLE REC
     ORD AND MUST BE IN THE SAME": PRINT "RECORD IN EACH RECORD GROUP.":
     PRINT
5190  PRINT : PRINT "WHICH RECORD, WITHIN A RECORD GROUP": INPUT "CONTAIN
     S THE KEY FIELD? ";KR
5200  PRINT : PRINT "WHICH CHARACTER, WITHIN THAT RECORD IS": INPUT "THE
     FIRST CHARACTER OF THE KEY FIELD?    ";KF
5210  PRINT : PRINT "HOW LONG, IN CHARACTERS, IS THE KEY": INPUT "FIELD?
     ";KL
5220  PRINT : PRINT "WE CAN ALLOW FOR A FILE WITH A 'HEADER'": PRINT "I.E
     . SOME INITIAL RECORDS WHICH ARE NOT"
5221  PRINT "A PART OF THE RECORD GROUPS TO BE": PRINT "SORTED.  IF THERE
      IS NO HEADER THEN ITS": PRINT "LENGTH IS SAID TO BE 0.": PRINT
5240  PRINT "HOW LONG, IN RECORDS, IS THE HEADER ON": INPUT "THE INPUT FI
     LE? ";HS
5490  RETURN
```

Fig. 4a. The routine which queries the user for information about the format of the file assumes that the user is not familiar with its use. It explains the meaning of various terms such as file header and key field before using those terms in its requests for information.

```
]RUN
WHAT IS THE NAME OF THE FILE TO BE
SORTED? CHAOTIC MESS
WHAT IS TO BE THE NAME OF THE SORTED
FILE? A GOOD SORT

THE INPUT FILE MUST BE A FIXED RECORD
LENGTH FILE.

WHAT IS THE LENGTH, IN CHARACTERS, OF
THE RECORDS (EXCLUDING THE FINAL <CR>)? 40

RECORDS IN THE INPUT FILE ARE CONSIDERED
TO BE GROUPED INTO WHAT WE CALL RECORD
GROUPS.  IF YOUR FILE IS NOT ORGANIZED
AS GROUPS THE NUMBER OF RECORDS IN A
GROUP IS SAID TO BE 1

HOW MANY RECORDS ARE IN A RECORD GROUP
IN THE INPUT FILE? 14

THE 'KEY FIELD' IS THE STRING OF CHAR-
ACTERS WITHIN EACH RECORD GROUP WHICH
WILL BE USED TO SORT THE RECORDS.
THE KEY FIELD MUST BE CONTAINED WITHIN
A SINGLE RECORD AND MUST BE IN THE SAME
RECORD IN EACH RECORD GROUP.


WHICH RECORD, WITHIN A RECORD GROUP
CONTAINS THE KEY FIELD? 3

WHICH CHARACTER, WITHIN THAT RECORD IS
THE FIRST CHARACTER OF THE KEY FIELD?   7

HOW LONG, IN CHARACTERS, IS THE KEY
FIELD? 25

WE CAN ALLOW FOR A FILE WITH A 'HEADER'
I.E. SOME INITIAL RECORDS WHICH ARE NOT
A PART OF THE RECORD GROUPS TO BE
SORTED.  IF THERE IS NO HEADER THEN ITS
LENGTH IS SAID TO BE 0.
HOW LONG, IN RECORDS, IS THE HEADER ON
THE INPUT FILE? 1
AT ROUTINE 6000
AT ROUTINE 2000
AT ROUTINE 1000
AT ROUTINE 3000
AT ROUTINE 4000
```

Fig. 4b. The first debugging run of the routine shown in Fig. 4a shows that it is working correctly. I felt that two additions should be made.

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subroutine which was to "get the sorting instructions from the user." It, too, was quite simple to program. The specification in Example 1 has a section called Inputs, and it was precisely those items of data that this routine needed to get from the user.

The original program for the routine at line 5000 is shown in Fig. 4a. Since the file sort program was not the kind of program that I expected to use frequently, I made the routine at line 5000 fairly verbose and nearly self-explanatory. Since it calls no subroutines, I did not need to provide any additional stubs.

The results of the first test run of the program with the subroutine at line 5000 are shown in Fig. 4b. Although the results indicated that the routine, when given correct input, was operating correctly, I stopped to consider what kinds of errors the user would be likely to make. The most significant error would be to specify a sort key that extended across the end of a record. As a result, I added the statements at line 5215 to check for this circumstance (see Example 2).

I also realized that the routine which would read the file and extract the key fields would need some way to know when all of the data had been read. If, when you are using Apple DOS, a routine attempts to read past the last record in the file, the message:

```
***DISK: END OF DATA ERROR
```

will be printed, and a program break will occur.

There are several ways of circumventing this problem. For example, files may contain a count of the number of records currently in the file in their header record (or record group). I, however, decided that the file sort program would assume that the data records in the file would be followed by a record which began with an end-of-file signal. This end-of-file signal would just be a string of characters (not extending past the end of the record) which would not be found as the first few characters of any data record group.

Having made these decisions, I added lines 5250–5270 to the routine (see Example 3). I assumed that this simple addition would work correctly and proceeded to program some of the other subroutines.

Parameters for Extracting Key Fields

I chose the routine at line 6000 as the next to be programmed. The role of this subroutine was to take the information obtained by the routine at line 5000 and set up the variables that would be needed to extract the key fields. In order to see what must be done in this routine, I annotated Fig. 2 to show the relationship between the information obtained by the 5000 routine and the location of the key fields.

The result of this exercise is shown in Fig. 5. I added the header and the end-of-file signal to the picture of the file and showed, in terms of the variables used in the routine at line 5000, the location of the key fields. As a result, I could see that there was little of value to be done in order to set up the parameters for extracting the key fields. In fact, I decided that the only useful function that should be included in this routine was the opening of the input file.

Opening the Input File. One of the most important and useful features of Apple DOS is that a program can do anything that you can do from the keyboard! The way that Apple DOS has been designed and implemented, the control-D is the magic character used to provide this feature. The rule is: if the *very first* character of a line being printed is a control-D, then the control-D is removed and the remainder of the line, formatted just as it would be for printing, is sent to Apple DOS just as though it had been typed on the keyboard.

This feature will be used throughout the file sort program, but its first appearance occurs in this routine, which is shown in Fig. 6. Line 6100 illustrates the use of this important feature of Apple DOS. Consider what would happen if that line were written as:

```
6100 PRINT "OPEN";OF$;",L";RL + 1
```

and OF$ was "CHAOTIC MESS" and the variable RL had the value 40. The execution of line 6100 would then cause:

```
OPEN CHAOTIC MESS,L41
```

to be printed (or displayed on the screen). In fact, if D$ had been assigned the value of the

File Sorting program.

```
0  REM  FILE SORT V7
1  REM  NOV. 19, 1978
2  REM  BY AL PRENTICE
10  DIM KY$(700),IX(700)
380  REM  D$ IS A CONTROL-D FOR DOS
390 D$ = ""
395  PRINT D$;"NOMON I,C,O"
400  REM  GET SORTING INSTRUC-   TIONS FROM THE USER.
410  GOSUB 5000
420  REM  SET UP PARAMETERS FOR  EXTRACTING KY$(N) AND IX(N).
430  GOSUB 6000
500  REM  EXTRACT KEY FIELDS,    KY$(N), AND ORIGINAL RECORD GROUP NUMBER
     S, IX(N).
510  GOSUB 2000
520  REM  SORT KY$(N) AND IX(N)  ON KY$(N).
530  GOSUB 1000
540  REM  WRITE THE SORT INDEX   FILE OUT
550  GOSUB 3000
560  REM  WRAP UP AND END
570  GOSUB 4000
580  REM  LIST THE SORTED FILE
590  GOSUB 7000
600  END
1000  REM  ----------------------
1010  REM  SHELL SORT FOR STRINGS
1020  REM  ----------------------
1021  PRINT : PRINT "----------------"
1100 GA =  INT (K / 2)
1110 I = GA + 1
1120 J = I - GA
1130 JG = J + GA
1140  IF KY$(J) <  = KY$(JG) THEN  GOTO 1400
1150 WK$ = KY$(J)
1155 W = IX(J)
1160 KY$(J) = KY$(JG)
1165 IX(J) = IX(JG)
1170 KY$(JG) = WK$
1175 IX(JG) = W
1200 J = J - GA
1210  IF J > 0 THEN  GOTO 1130
1400 I = I + 1
1410  IF I <  = K THEN  GOTO 1120
1500 GA =  INT (GA / 2)
1510  IF GA >  = 1 THEN  GOTO 1110
1990  RETURN
2000  REM  ----------------------
2010  REM  EXTRACT KEY FIELDS
2020  REM  ----------------------
2100 K = 0
2110 FI = 0
2120  PRINT D$;"READ ";OF$;",R";HS + K * RG;",B0"
2130  INPUT "1ST RECORD? ";WK$
2140  IF  LEFT$ (WK$, LEN (EF$)) = EF$ THEN  GOTO 2500
2145  IF KR <  > 1 THEN  GOTO 2150
2147 KY$(K + 1) =  MID$ (WK$,KF,KL)
2149  GOTO 2180
2150  PRINT D$;"READ ";OF$;",R";HS + K * RG + KR - 1;",B";KF -
2160  INPUT "KEY FIELD? ";WK$
2170 KY$(K + 1) =  LEFT$ (WK$,KL)
2180 IX(K + 1) = K
2190 K = K + 1
2200  GOTO 2600
2500 FI = 1
2600  IF FI = 0 THEN  GOTO 2120
2990  RETURN
3000  REM  ----------------------
3010  REM   WRITE THE SORT INDEX
3020  REM       FILE OUT
3030  REM  ----------------------
3100  PRINT D$;"OPEN ";SF$
3110  PRINT D$;"WRITE ";SF$
3120  FOR I = 1 TO K
3130  PRINT IX(I)
3140  NEXT I
3150  PRINT "-999": REM  NUMERIC EOF
3160  PRINT D$
3170  RETURN
4000  REM  ----------------------
4010  REM  WRAP UP THE DETAILS
4020  REM  ----------------------
4100  PRINT D$;"CLOSE ";OF$
4110  PRINT D$;"CLOSE ";SF$
4990  RETURN
```

```
5215 IF KL + KF - 1>RL THEN PRINT "THAT WOULD GO PAST THE END OF THE
     RECORD":GOTO 5210
```

Example 2.

null string (e.g., D$ = ""), the same result would have been obtained. On the other hand, if D$ had been assigned the % value, the execution of line 6100 would have printed:

```
%OPEN CHAOTIC MESS,L41.
```

When D$ has the value of a control-D, it is as though it were the null string, but the message (OPEN CHAOTIC MESS,L41) is sent to Apple DOS in such a way that it appears to have come from the keyboard! Apple DOS interprets that message as meaning "open (i.e., get ready to write or read) the file whose name is CHAOTIC MESS, which is a fixed-record-length file in which all records are 41 characters long."

This clever control-D arrangement used by Apple DOS not only permits programs to do what we can do from the keyboard, but also provides for a useful debugging technique. Using a variable name, such as D$, in each DOS command print statement not only makes the DOS commands easily recognizable in the program, but also permits us to assign some value other than control-D to that variable. We can assign the variable some other value such as % and debug our program without ever actually using DOS. This permits us to debug the program more safely than we could if all our debugging runs had to actually read and/or write the disk.

Before proceeding to the debugging of the routine at line 6000, I also wrote the routine at line 4000. It, too, has a simple job to do. Although more may need to be added later, I knew at this point that this routine must "close" the file OF$. Closing a file is just a way of telling DOS that we are through reading or writing the file, but it also can be important in other ways.

While a file is "open," DOS uses a 600 byte buffer to maintain some information about the file that it needs for its operation. There is one such buffer in use for each open file. A program that, during its course of execution, must read or write many files can minimize the number of such buffers in use by opening and closing files judiciously. This is not a problem with the file sort program; however, if files are not closed when using DOS, incorrect re-

```
5000  REM  ----------------------
5010  REM  GET THE SORING INSTR-  UCTIONS FROM THE USER.
5020  REM  ----------------------
5100  PRINT "WHAT IS THE NAME OF THE FILE TO BE"
5101  INPUT "SORTED? ";OF$
5120  PRINT "WHAT IS TO BE THE NAME OF THE SORTED"
5121  INPUT "FILE? ";SF$
5130  PRINT : PRINT "THE INPUT FILE MUST BE A FIXED RECORD": PRINT "LENGT
    H FILE.": PRINT
5140  PRINT "WHAT IS THE LENGTH, IN CHARACTERS, OF": INPUT "THE RECORDS (
    EXCLUDING THE FINAL <CR>)? ";RL
5150  PRINT : PRINT "RECORDS IN THE INPUT FILE ARE CONSIDERED": PRINT "TO
     BE GROUPED INTO WHAT WE CALL RECORD"
5160  PRINT "GROUPS.  IF YOUR FILE IS NOT ORGANIZED": PRINT "AS GROUPS TH
    E NUMBER OF RECORDS IN A": PRINT "GROUP IS SAID TO BE 1": PRINT
5170  PRINT "HOW MANY RECORDS ARE IN A RECORD GROUP": INPUT "IN THE INPUT
     FILE? ";RG
5180  PRINT : PRINT "THE 'KEY FIELD' IS THE STRING OF CHAR-": PRINT "ACTE
    RS WITHIN EACH RECORD GROUP WHICH": PRINT "WILL BE USED TO SORT THE
    RECORDS."
5185  PRINT "THE KEY FIELD MUST BE CONTAINED WITHIN": PRINT "A SINGLE REC
    ORD AND MUST BE IN THE SAME": PRINT "RECORD IN EACH RECORD GROUP."
    : PRINT
5190  PRINT : PRINT "WHICH RECORD, WITHIN A RECORD GROUP": INPUT "CONTAIN
    S THE KEY FIELD? ";KR
5200  PRINT : PRINT "WHICH CHARACTER, WITHIN THAT RECORD IS": INPUT "THE
    FIRST CHARACTER OF THE KEY FIELD?   ";KF
5210  PRINT : PRINT "HOW LONG, IN CHARACTERS, IS THE KEY": INPUT "FIELD?
    ";KL
5215  IF KL + KF - 1 > RL THEN  PRINT "THAT WOULD GO PAST THE END OF THE
    RECORD": GOTO 5210
5220  PRINT : PRINT "WE CAN ALLOW FOR A FILE WITH A 'HEADER'": PRINT "I.E
    . SOME INITIAL RECORDS WHICH ARE NOT"
5221  PRINT "A PART OF THE RECORD GROUPS TO BE": PRINT "SORTED.  IF THERE
     IS NO HEADER THEN ITS": PRINT "LENGTH IS SAID TO BE 0.": PRINT
5240  PRINT "HOW LONG, IN RECORDS, IS THE HEADER ON": INPUT "THE INPUT FI
    LE? ";HS
5250  PRINT "EACH FILE MUST END WITH AN 'END-OF-FILE': PRINT "RECORD.  TH
    IS IS A RECORD WHICH DOESN'T"
5260  PRINT "GET SORTED BUT CONTAINS A STRING OF": PRINT "CHARACTERS WHIC
    H IS UNIQUE."
5270  PRINT : INPUT "WHAT DOES THE EOF RECORD CONTAIN? ";EF$
5490  RETURN
6000  REM  ----------------------
6010  REM  SET UP PARAMETERS FOR  EXTRACTING KEY FIELDS
6020  REM  ----------------------
6090  REM  NOTE THAT THE 'OPEN'  ASSUMES THAT THE INPUT FILE IS ON THE 'C
    URRENT' SLOT,   DEVICE AND VOLUME.
6100  PRINT D$;"OPEN ";OF$;",L";RL + 1
6990  RETURN
7000  REM  ----------------------
7010  REM  LIST THE SORTED FILE
7020  REM  ----------------------
7100  INPUT "DO YOU WANT TO LIST THE SORTED FILE? ";AN$
7110  IF  LEFT$ (AN$,1) <  > "Y" THEN  GOTO 7990
7120  REM  TURN ON THE PRINTER
7130  GOSUB 8000
7150  REM  OPEN THE DATA FILE
7160  PRINT D$;"OPEN ";OF$;",L";RL + 1
7170  FOR JJ = 1 TO K
7180  FOR KK = 1 TO RG
7190  PRINT D$;"READ ";OF$;",R";HS + IX(JJ) * RG + KK - 1
7200  INPUT LI$
7210  PRINT LI$
7220  NEXT KK
7230  IF RG > 1 THEN  PRINT : PRINT : PRINT
7240  NEXT JJ
7250  REM  TURN OFF THE PRINTER
7260  GOSUB 9000
7990  RETURN
8000  REM  ----------------------
8010  REM   TURN ON THE PRINTER
8020  REM  ----------------------
8100  PRINT D$;"BLOAD RS232 DOS 36K"
8110  CALL 768
8120  RETURN
9000  REM  ----------------------
9010  REM   TURN OFF THE PRINTER
9020  REM  ----------------------
9100  PRINT D$;"PR#0"
9110  RETURN
10000  REM  DUMP THE SORTED TABLE
10005  FOR JJ = 1 TO K
10010  PRINT JJ;" ";IX(JJ);" ";KY$(JJ)
10020  NEXT JJ
10030  RETURN
```

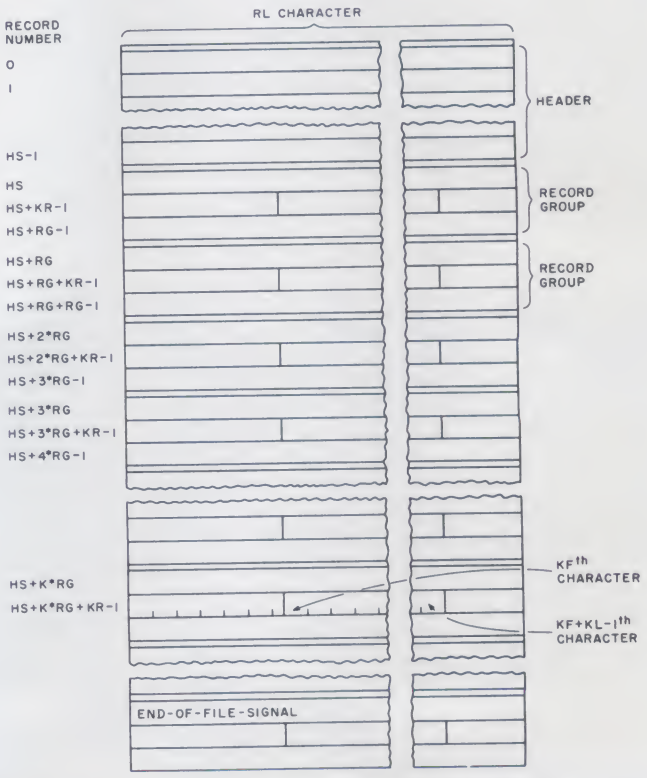


Fig. 5. The organization of the file is extended from that shown in Fig. 2. The header and end-of-file signal have been added. The record numbers are shown in terms of the variables assigned by "get sorting instructions" routine (line 5000).

```
5250 PRINT "EACH FILE MUST END WITH AN 'END-OF-FILE' ":
     PRINT "RECORD. THIS IS A RECORD WHICH DOESN'T"
5260 PRINT "GET SORTED BUT CONTAINS A STRING OF":
     PRINT "CHARACTERS WHICH IS UNIQUE."
5270 PRINT:INPUT "WHAT DOES THE EOF RECORD CONTAIN?"
     ;EF$
```

Example 3.

```
6000  REM  ----------------------
6010  REM  SET UP PARAMETERS FOR  EXTRACTING KEY FIELDS
6020  REM  ----------------------
6090  REM  NOTE THAT THE 'OPEN'  ASSUMES THAT THE INPUT FILE IS ON THE 'C
     URRENT' SLOT,   DEVICE AND VOLUME.
6100  PRINT D$;"OPEN ";OF$;",L";RL + 1
6990  RETURN
```

Fig. 6. The routine needs only to tell Apple DOS the name of the file that it is to read. The command is issued through line 6100. If D$ is a control-D character, OF$ = "UNSORTED.FILE" and RL = 39, then the message "OPEN UNSORTED.FILE,L40" will be sent to Apple DOS. If, however, D$ had been assigned the value %, the message %OPEN UNSORTED.FILE,L40 would only be printed or displayed and no command would have been received by Apple DOS.

sults may be obtained. (Apple DOS "buffers" the output to files which are being written. That is, data which is to be written to the file is kept in the buffer in memory until the buffer is full, and it is then written to the disk. If a file is not closed, the data remaining in the buffer will not be written to the file.) The rule to be followed is "close all files!" The programming for the routine at line 4000 is shown in Fig. 7.

Debugging the Subroutines 4000 and 6000. The debugging of the subroutines at lines 4000 and 6000 began with the addition of the following two lines to the top level program:

```
380 REM D$ IS A CONTROL-D FOR DOS
390 D$ = "%"
```

The remark line describes what I would do later, but for debugging, I set D$ to %. I then ran the program and obtained the results shown in Fig. 8.

Note that when the program asked for the length of the key field I gave the answer 46. I had

```
4000  REM  ----------------------
4010  REM  WRAP UP THE DETAILS
4020  REM  ----------------------
4100  PRINT D$;"CLOSE ";OF$
4990  RETURN
```

Fig. 7. The initial version of this routine only closes the file. It issues the CLOSE command in the same way as the routine in Fig. 6 issues the OPEN command.

previously said that the records in the file were all only 40 characters long, and thus a key length of 46 characters would certainly cause a key field to extend across the boundary between two records. The debugging run shows that the addition, made at line 5215, worked correctly in detecting this error. More important, the last few lines of the run show that the routines at lines 6000 and 4000 would be sending the correct commands to Apple DOS.

You may have been wondering why our open command gives the length of the records as RL + 1 rather than RL. In Apple DOS terminology, a record is a string of characters whose *last* character is a carriage return. Thus a record which has 40 *data* characters is 41 characters long because the length includes the carriage return at the end of the record.

I assumed that the user of the sort program would more naturally think about the number of data characters in a record than about the technical length of a record as seen by Apple DOS. In fact, the only place where this issue arises is in an OPEN command, so the program asks the user for the data length and uses that value everywhere, except in the open command.

Having completed the top level program and the first two subroutines, we're well on our way. Next month, we'll finish the job by writing the remaining subroutines and adding some final touches.■

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*Sort timings shown below are nominal times. Times will vary based on sort and system configurations. Nominal times based on Mod I 48K 4-drive configuration, 64 byte records, and 5 sort keys.

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SORT	16K	33	SORT	340K	1081
SORT	32K	49	SORT	680K	2569
SORT	85K	173	SORT and MERGE	85K SORT + 1275K Merge	1757
SORT	170K	445			

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```
]RUN
WHAT IS THE NAME OF THE FILE TO BE
SORTED? CHAOTIC MESS
WHAT IS TO BE THE NAME OF THE SORTED
FILE? A GOOD SORT

THE INPUT FILE MUST BE A FIXED RECORD
LENGTH FILE.

WHAT IS THE LENGTH, IN CHARACTERS, OF
THE RECORDS (EXCLUDING THE FINAL <CR>)? 40
.
.
.
HOW MANY RECORDS ARE IN A RECORD GROUP
IN THE INPUT FILE? 14
.
.
.

WHICH RECORD, WITHIN A RECORD GROUP
CONTAINS THE KEY FIELD? 3

WHICH CHARACTER, WITHIN THAT RECORD IS
THE FIRST CHARACTER OF THE KEY FIELD?   7

HOW LONG, IN CHARACTERS, IS THE KEY
FIELD? 46
THAT WOULD GO PAST THE END OF THE RECORD

HOW LONG, IN CHARACTERS, IS THE KEY
FIELD? 25
.
.
.
HOW LONG, IN RECORDS, IS THE HEADER ON
THE INPUT FILE? 3
.
.
.

WHAT DOES THE EOF RECORD CONTAIN? END-OF-FILE-MARK
%OPEN CHAOTIC MESS,L41
AT ROUTINE 2000
AT ROUTINE 1000
AT ROUTINE 3000
%CLOSE CHAOTIC MESS
```

Fig. 8. This debugging run shows that the addition that checks for a key field that extends past the end of the record is working. It also shows the Apple DOS commands, which would have been issued had D$ been assigned the value control-D rather than %.

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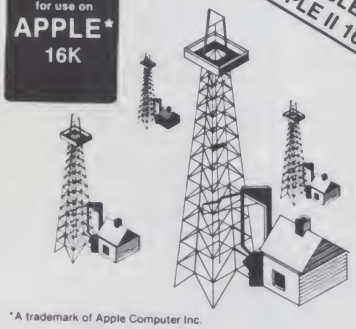
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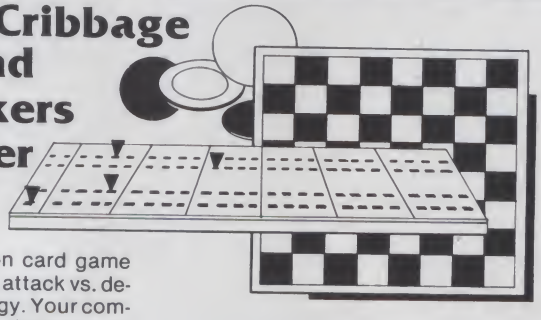
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Computer Minds School Corporation

To keep track of nine schools, 3400 students and 650 to 800 employees, the Logansport, Indiana, Community School Corporation chose an MSI microcomputer system.

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The Logansport, Indiana, Community School Corporation has within its district nine elementary schools, three middle schools and one high school. Total enrollment is approximately 3400 students. During an average year, the school corporation employs from 650 to 800 persons. The corporation receives fund allocations from many different sources, including federal grants, state aid and co-ops.

Several years ago, the Indiana legislature set new requirements to which community school corporations had to conform to standardize their bookkeeping, accounting and financial reporting procedures. To comply with new legislation, school corporations have had to adopt modern accounting procedures and equipment, often requiring the use of computer systems.

According to Controller Bob Lease, the school corporation decided to acquire a new business system for several reasons. "Our old mechanical bookkeeping system was in bad shape and we couldn't get a service contract on it. In addition, we were paying the bank $4000 to $5000 a year to do our payroll."

In 1977, Dr. Randy Mauck, assistant superintendent/business of the Logansport Community School Corporation, and other Logansport school officials began a search of available equipment, including small computer systems, which would enable their corporation to comply with the legislation and provide a versatile accounting system. The school officials studied options offered by Burroughs Corporation, NCR and other well-known suppliers of business computer systems. They learned that a system capable of handling their needs would cost over $50,000. Furthermore, they were assured that their requirements were too complex for a microcomputer system to handle.

However, because of the experience of one school-board member, Mike Muehlhausen, with Midwest Scientific Instruments microcomputer systems, the board recommended contacting MSI as a possible vendor for the new accounting system.

In 1977, Charles C. Childress of Midwest Scientific Instruments, Inc., demonstrated an MSI system to Dr. Mauck and other Logansport school officials. They ascertained that the MSI system could do the job and, as a result, installed an MSI 6800 at the school headquarters. The corporation made a software development contract to produce all of the required application programs with Joe Zellers, production engineer for Myers Spring Company of Logansport, another user of MSI systems.

The equipment selected for the installation included an MSI 6800 with 56K of memory, a four-drive FD-8 floppy-disk memory system, a Lear-Siegler CRT terminal and a Decwriter printer.



Logansport Community School Corporation school officials and programmer (l-r): Controller Bob Lease; Assistant Superintendent/Business Randy Mauck; Joe Zellers, production engineer for Myers Spring Company and contract programmer for the Logansport school system.

Functions of the Computer System

To develop applications software programs that would meet the total accounting requirements of the school corporation was

a demanding job. Nevertheless, Lease and Zellers set out to fulfill these requirements. "The system was programmed so that non-data-processing people could understand and use it immediately. After ten minutes, an operator could use the machine, whereas our old system required about a week of training," said Lease. "We adapted the system to our personnel instead of adapting our personnel to the system." After approximately eight months of software development, the computer system was fully functional. The MSI system provides many accounting functions for the school corporation, several of which are outlined below.

Payroll. The $300,000 payroll requires about a day and a half to run. One full day is required to input the data for all employees for that particular pay period. The continuous-form checks are printed in approximately 4½ hours and are automatically issued in batches for each particular school. This alleviates the problem of sorting the checks for distribution to employees at different locations. Payroll records are available alphabetically for easy reference to any particular employee. "The older system required all references to the payroll records to be made by the employee number, which required a dual lookup procedure, first to find the number that was associated with the particular name, and then go to the file numerically to find the actual payroll data. The MSI system that we have now prints everything alphabetically, allowing easy reference to any individual payroll record," Lease explained.

A payroll parameter file is also available. It stores employee birth dates, employment dates, details of employment contracts, pay rates, withholding, overtime, dues, insurance, sick leave, annual leave and other information. Each payroll check contains the status of the employee's sick leave and annual leave, which simplified related accounting procedures. Any changes made to the categories of leave status are updated each pay period so the employee is aware of any necessary corrections or adjustments. (See Photo 1.)

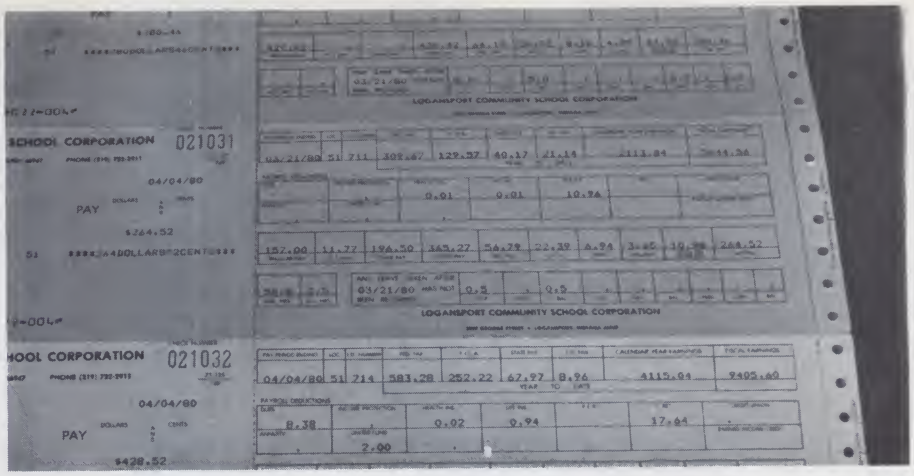


Photo 1. Payroll checks.

Fund Ledger and Ledger of Receipts. All disbursements by the school corporation must be made against over 400 specific fund titles. The MSI system keeps track of the funds. Each disbursement must be recorded with date, check number and description. The system stores this information on disk memory and allows a report to be generated upon demand for each of the appropriate funds. Continuous forms are used for this purpose. The system automatically provides ledgers of appropriations, allotments, encumbrances, disbursements and balances. (See Fig. 1.)

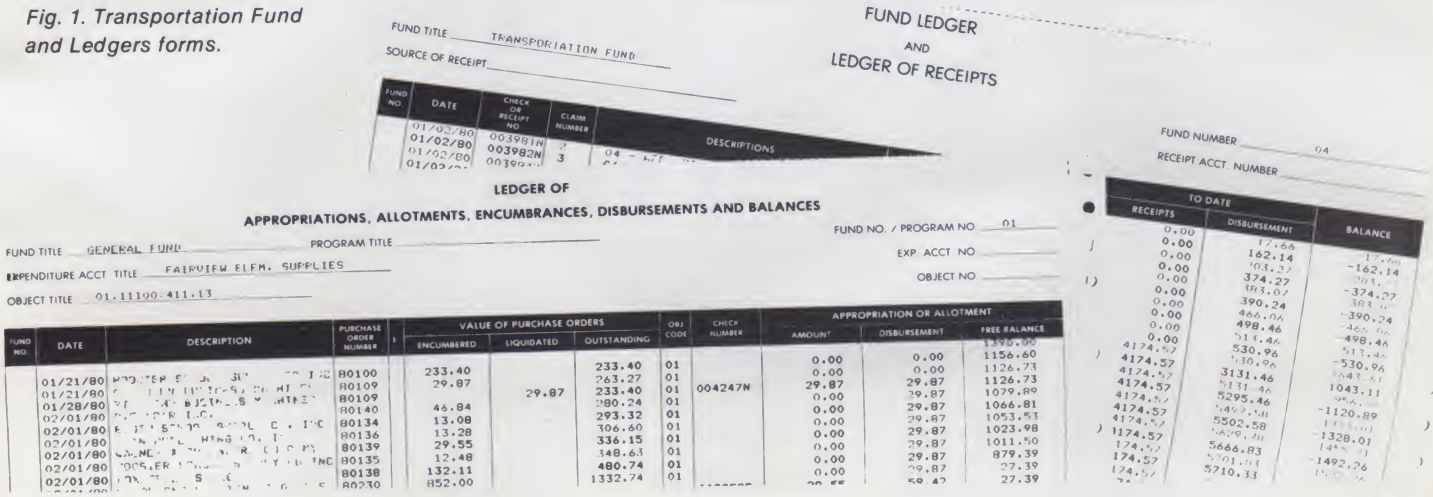
Monthly Reports. The system automatically provides monthly reports on the condition of the general fund. These reports can be distributed to various administrators as required. Reports are available for each individual school, as well, which allows the school principals to quickly examine their own budgets and to see the status of various departmental items. Composite reports, showing the overall picture, are available for the school superintendent and other school officials.

Teacher Contracts. Contracts for teachers are stored on disk memory. Each year when teacher contracts are renewed, the MSI system can edit them, appropriately updating the contracts. The contracts are printed in about two days, eliminating almost two weeks of secretarial work.

Energy Management. An energy-management program allows the intelligent examination of the energy utilization of each building to make comparisons of the buildings within the school corporation. This report summarizes the use of gas and electricity and provides a complete cost analysis. According to school officials, this program has been valuable in monitoring the energy-conservation program of the school corporation.

Investment Accounting. The system automatically keeps track of cash that has been deposited in the form of bank certificates of deposit. A constantly updated rec-

Fig. 1. Transportation Fund and Ledgers forms.



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ord of interest and earnings is listed along with due dates.

Conclusions

Controller Bob Lease, who has had no previous programming experience, has learned to make program modifications without relying upon an outside programmer.

According to Lease, "The system has been extremely reliable since installed two years ago. During that time, only on three occasions have we had any down-time. These failures were all corrected in less than one day each and were attributed to a printer failure and two other minor failures as a result of static discharge during the winter months." (A portable humidifier corrected the static problem.) The computer is in use an average of 75 percent of each day, with more use expected.

The entire system was installed for less than $25,000, including the software-development contract, a system-cost of one-third to one-half the cost of a typical system from one of the larger suppliers.

The Logansport Community School Corporation plans to use the system for grade reporting and averaging, class schedules, test scores and other functions by incorporating a hard disk to increase storage capacity, speed and capabilities. ■

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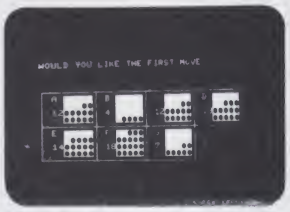
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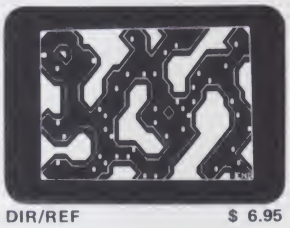
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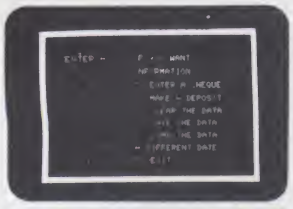
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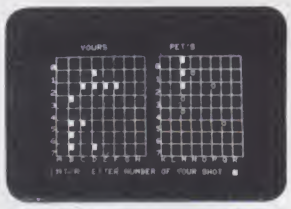


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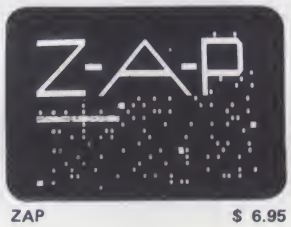


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Jon Kapecki
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Rochester NY 14620

Computerized Air Conditioning

This adaptable BASIC program will adapt the climate of your house in summer.

If you're planning to buy a room air conditioner to keep you and your computer cool this summer, here's a useful—and money-saving—program for you and the computer.

Buying an air conditioner is not simply a matter of walking into an appliance store and picking out a unit that looks as though it will fit into the window. It pays to match the rated cooling capacity of the air conditioner to your true cooling needs.

Obviously, a unit that's too small won't sufficiently cool the room. Furthermore, the excess cooling load is apt to keep the unit running almost full-time. The result is extra wear on the unit's mechanical parts, such as the compressor, as well as continuous noise, which is especially irritating at night.

An air conditioner that's too big will, of course, waste money that you could have spent on more important things—like a second disk drive, for example. But worse, the unit may cool the room too quickly to adequately dehumidify it. The result will be a room that's cool, but clammy. In addition, the room temperature may not stay as uniform as with a properly matched unit because the big air conditioners will tend to cycle on infrequently with wide swings from too cool to too warm.

```
275  PRINT "HOW MANY WINDOWS FACE";
277  ON J GOTO 2000,2002,2004,2006,2008,2010,2012,2014
                .
                .
                .
                .
2000 PRINT "NORTHEAST";
2001 GOTO 280
2002 PRINT "EAST";
2003 GOTO 280
2004 PRINT "SOUTHEAST";
2005 GOTO 280
etc.
```

Example 1.

```
FOR J = 1 TO 8
FOR K = 1 TO 3
READ Q(J,K)
NEXT K
NEXT J
```

Example 2.

```
DIM Q(24) . . . .
                .
                .
                .
                .
FOR I = 1 TO 24
READ Q(I)
NEXT I
                .
                .
                .
                .
W(J) = W(J) + X*Y*Q(K + 3*(J - 1))*F
```

Example 3.

How to Use and Apply Program

This program is the answer. It's designed to match your cooling needs to the Btu-per-hour rating of the air conditioner (Btu's are British thermal units, the heat needed to raise one pound of water by 1° F). It was developed from a standard devised by the Association of Home Appliance Manufacturers and takes into account conducted and radiated heat, appliances and number of people in the room, your local climate and other factors.

To use the program you'll need to know the dimensions (in feet) of doors, windows and walls in the room of interest, as well as the amount of insulation and adjacent spaces. The prologue to the program tells you exactly what numbers you'll need. In addition, you'll need to enter your climate-correction factor, a number near unity based on where you live. The map in Fig. 1 gives values for the contiguous United States, or the program can help you come up with a good estimate.

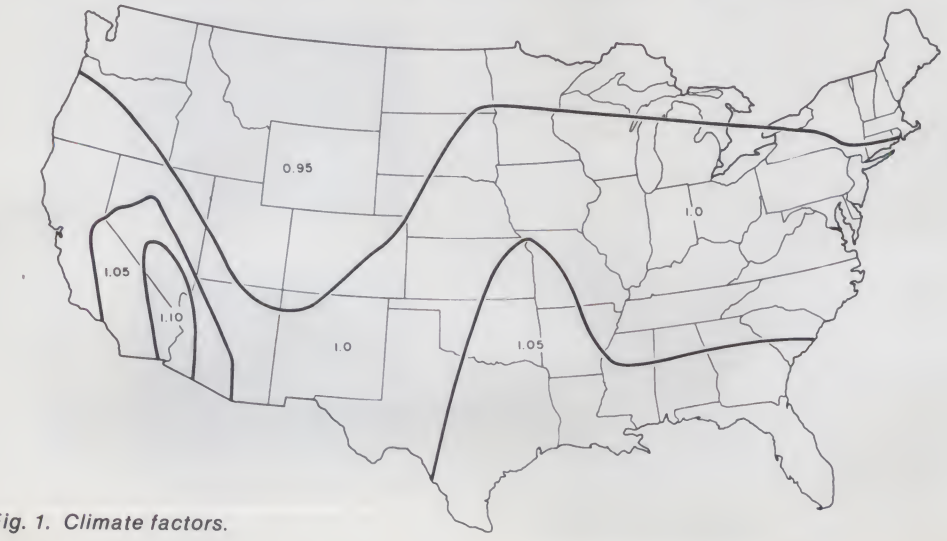


Fig. 1. Climate factors.

All air conditioners sold now are required by law to give their EER, or energy efficiency ratio (a number usually in the range of 7 to 12). Couple this with your cost of electricity (in kilowatt hours) and the number of cooling hours per season—both numbers should be available from your local power company—and you can estimate the cost of running the air conditioner. This can help in comparing models with different prices

```
AIR CONDITIONING COOLING LOAD
ADAPTED FROM ASSN. OF HOME APPLIANCE MANUFACTURERS
STANDARD RAC-1

YOU WILL NEED TO KNOW THE FOLLOWING DIMENSIONS (IN FEET):
1. WIDTH OF ALL OPEN DOORWAYS OR ARCHES INTO THE
   ROOM FROM UNCOOLED ROOMS
2. LENGTH AND WIDTH OF ALL WINDOWS
3. LENGTH OF WALLS
4. CEILING DIMENSIONS
5. FLOOR DIMENSIONS

YOU WILL ALSO NEED TO ESTIMATE:
1. THE CLIMATE CORRECTION FACTOR
2. THE TOTAL WATTAGE OF LIGHTS AND APPLIANCES
3. THE NUMBER OF PEOPLE WHO NORMALLY USE THE ROOM
   AT ONE TIME

IF YOU WISH TO ESTIMATE COOLING COSTS, YOU WILL ALSO
NEED YOUR ELECTRIC RATE, THE COOLING HOURS PER SEASON
(SEE YOUR POWER COMPANY FOR BOTH), AND THE EER (ENERGY
EFFICIENCY RATIO) OF THE AIR CONDITIONER (SEE THE
REQUIRED APPLIANCE TAG).

ARE YOU READY TO BEGIN?YES
PLEASE NOTE ALL MEASUREMENTS ARE IN FEET.

HOW MANY OPEN DOORWAYS OR ARCHES LEAD INTO UNCOOLED AREAS?2
WHAT IS THE WIDTH OF DOOR (ARCH) # 1
?4
WHAT IS THE WIDTH OF DOOR (ARCH) # 2
?4


HOW MANY WINDOWS IN THE ROOM FACE NORTHEAST?0

HOW MANY WINDOWS IN THE ROOM FACE EAST?1
WIDTH,HEIGHT FOR WINDOW # 1
?6,6
DOES THE WINDOW HAVE (SELECT #):
     1. NO SHADES OR AWNINGS
     2. INSIDE SHADES
     3. AWNINGS
     4. BOTH
?1
IS THE WINDOW GLASS BLOCK?YES

HOW MANY WINDOWS IN THE ROOM FACE SOUTHEAST?0

HOW MANY WINDOWS IN THE ROOM FACE SOUTH?0

HOW MANY WINDOWS IN THE ROOM FACE SOUTHWEST?0

HOW MANY WINDOWS IN THE ROOM FACE WEST?1
WIDTH,HEIGHT FOR WINDOW # 1
?4,6
DOES THE WINDOW HAVE (SELECT #):
     1. NO SHADES OR AWNINGS
     2. INSIDE SHADES
     3. AWNINGS
     4. BOTH
?2
IS THE WINDOW GLASS BLOCK?NO
IS THE WINDOW DOUBLE GLASS OR A STORM WINDOW?YES

HOW MANY WINDOWS IN THE ROOM FACE NORTHWEST?0

HOW MANY WINDOWS IN THE ROOM FACE NORTH?2
WIDTH,HEIGHT FOR WINDOW # 1
?4,6
DOES THE WINDOW HAVE (SELECT #):
     1. NO SHADES OR AWNINGS
     2. INSIDE SHADES
     3. AWNINGS
     4. BOTH
?2
IS THE WINDOW GLASS BLOCK?NO
IS THE WINDOW DOUBLE GLASS OR A STORM WINDOW?YERS
WIDTH,HEIGHT FOR WINDOW # 2
?4,6
DOES THE WINDOW HAVE (SELECT #):
     1. NO SHADES OR AWNINGS
     2. INSIDE SHADES
     3. AWNINGS
     4. BOTH
?2
IS THE WINDOW GLASS BLOCK?NO
IS THE WINDOW DOUBLE GLASS OR A STORM WINDOW?YES

ARE THE OUTSIDE WALLS OF THE ROOM (SELECT#)
1. UNINSULATED FRAME OR MASONRY < 8 INCHES THICK
2. INSULATED OR MASONRY > 8 INCHES THICK
?2
WHAT IS THE LENGTH OF ALL NORTHERN EXPOSURE WALLS?30
WHAT IS THE LENGTH OF ALL OTHER OUTSIDE WALLS
   SHADED BY ADJACENT BUILDINGS?15
WHAT IS THE LENGTH OF ALL REMAINING OUTSIDE WALLS?15
WHAT IS THE LENGTH OF ALL WALLS BETWEEN THIS AND
   ANY UNCOOLED ROOMS?30

IS THE ROOM CEILING (SELECT#)
1. UNINSULATED WITH NO SPACE ABOVE
2. INSULATED WITH NO SPACE ABOVE
3. UNINSULATED WITH ATTIC OR CRAWL SPACE ABOVE
4. INSULATED WITH ATTIC OR CRAWL SPACE ABOVE
5. OCCUPIED SPACE ABOVE
?5
ENTER THE WIDTH AND LENGTH OF CEILING
?15,30

IS THE ROOM FLOOR DIRECTLY ON THE GROUND
OR OVER A BASEMENT (Y OR N)?YES

ENTER YOUR CLIMATE FACTOR IF YOU CAN OBTAIN IT
(ELSE ENTER 0)?0
WE CAN TRY AND ESTIMATE YOUR CLIMATE FACTOR
DO YOU LIVE IN THE NEW ENGLAND STATES,WASHINGTON,
   NORTHERN OREGON, MONTANA, IDAHO, WYOMING, UTAH,
   N. DAKOTA, WESTERN COLORADO, WESTERN S. DAKOTA,
   NORTHERN MINNESOTA, OR NEW YORK (EXCEPT THE
   NEW YORK CITY AREA)?YES

YOUR CLIMATE FACTOR IS ESTIMATED AS  .95

HOW MANY PEOPLE WILL NORMALLY OCCUPY THE ROOM?3

WHAT IS THE TOTAL WATTAGE OF ALL ELECTRICAL
    EQUIPMENT AND LIGHTS IN THE ROOM (NOT INCLUDING
    THE AIR CONDITIONER ITSELF?800

**************************************************
THE BTU/HOUR COOLING LOAD IS
      FULL-TIME USE = 11986.2
         CHOOSE A UNIT IN THE RANGE OF  13184
         TO  10787   BTU/HOUR
      NIGHTS ONLY = 9715.7
         CHOOSE A UNIT IN THE RANGE OF  10687
         TO  8744    BTU/HOUR
**************************************************

DO YOU WISH TO ESTIMATE COOLING COSTS FOR SPECIFIC MODELS?YES
ENTER YOUR ELECTRIC RATE IN CENTS/KILOWATT-HOUR?.054
ARE YOU SURE THAT'S IN CENTS/KILOWATT-HOUR?
ENTER YOUR ELECTRIC RATE IN CENTS/KILOWATT-HOUR?5.4
ENTER THE AVERAGE NUMBER OF COOLING HOURS/SEASON?1440

ENTER THE EER (ENERGY EFFICIENCY RATIO) FOR THE
    AIR CONDITIONER (ENTER 0 TO STOP)?9.6
APPROXIMATE ANNUAL COST OF OPERATION (DAYS & NIGHTS)$ 97.09

ENTER THE EER (ENERGY EFFICIENCY RATIO) FOR THE
    AIR CONDITIONER (ENTER 0 TO STOP)?14.0
APPROXIMATE ANNUAL COST OF OPERATION (DAYS & NIGHTS)$ 66.57

ENTER THE EER (ENERGY EFFICIENCY RATIO) FOR THE
    AIR CONDITIONER (ENTER 0 TO STOP)?0

END OF RUN******
```

Sample run.

and EERs.

You can also use the program to easily compare your savings—both in the initial cost of the unit and in future utility bills—gained by adding insulation, shades or awnings to the room. Just rerun the program with these room modifications included.

The Program

The program is written in Hewlett-Packard BASIC, but with the exception of one type of string statement and perhaps the optional PRINT USING format, it should require few changes for use with other computers. Y$ (1,1) represents the first character of the string Y$ and permits the program to recognize either YES or Y as an answer to a question. Your version of BASIC may perform the same truncation with a LEFT function. The DIM statement C$(8,9) just calls for a string array of eight entries, each of a maximum length of nine.

You can easily modify the program to run without string functions at all. Just let yes = 1 and no = 0. The directions printed by the string function in line 275 can be simulated by a single or multi-branched GOTO using ordinary PRINT statements as the targets (see Example 1).

If your BASIC lacks a MAT READ statement, just use a pair of nested FOR loops to read the constants into the array (see Example 2). Finally, if you have only singly dimensioned variables, use the patch shown in Example 3. Keep cool! ■

Program listing begins on next page.

Program listing.

```
COOL
   5 DIM I$(72),W(8),C$(8,9),Q(8,3),R(3,2),U(5,2)
  10 MAT READ C$,Q,R,U
  15 PRINT "AIR CONDITIONING COOLING LOAD"
  20 PRINT "ADAPTED FROM ASSN. OF HOME APPLIANCE MANUFACTURERS"
  25 PRINT "STANDARD RAC-1"
  30 REM VER 1.1--JANUARY '79--KAPECKI
  35 PRINT
  40 PRINT "YOU WILL NEED TO KNOW THE FOLLOWING DIMENSIONS (IN FEET):"
  45 PRINT "1. WIDTH OF ALL OPEN DOORWAYS OR ARCHES INTO THE"
  50 PRINT "   ROOM FROM UNCOOLED ROOMS"
  55 PRINT "2. LENGTH AND WIDTH OF ALL WINDOWS"
  60 PRINT "3. LENGTH OF WALLS"
  65 PRINT "4. CEILING DIMENSIONS"
  70 PRINT "5. FLOOR DIMENSIONS"
  75 PRINT
  80 PRINT "YOU WILL ALSO NEED TO ESTIMATE:"
  85 PRINT "1. THE CLIMATE CORRECTION FACTOR"
  90 PRINT "2. THE TOTAL WATTAGE OF LIGHTS AND APPLIANCES"
  95 PRINT "3. THE NUMBER OF PEOPLE WHO NORMALLY USE THE ROOM"
 100 PRINT "   AT ONE TIME"
 105 PRINT
 110 PRINT "IF YOU WISH TO ESTIMATE COOLING COSTS, YOU WILL ALSO"
 115 PRINT "NEED YOUR ELECTRIC RATE, THE COOLING HOURS PER SEASON"
 120 PRINT "(SEE YOUR POWER COMPANY FOR BOTH), AND THE EER (ENERGY"
 125 PRINT "EFFICIENCY RATIO) OF THE AIR CONDITIONER (SEE THE "
 130 PRINT "REQUIRED APPLIANCE TAG)."
 135 PRINT
 140 PRINT "ARE YOU READY TO BEGIN";
 145 INPUT I$
 150 IF I$(1,1)<>"Y" THEN STOP
 155 PRINT "PLEASE NOTE ALL MEASUREMENTS ARE IN FEET."
 160 PRINT
 165 S1=0
 170 S2=0
 175 W1=0
 180 W2=0
 185 PRINT "HOW MANY OPEN DOORWAYS OR ARCHES LEAD INTO UNCOOLED AREAS";
 190 INPUT N
 195 IF N<1 THEN 255
 200 FOR I=1 TO N
 205   PRINT "WHAT IS THE WIDTH OF DOOR (ARCH) #";I
 210   INPUT X
 215   IF X<=5 THEN 240
 220   PRINT "THE ROOM CONNECTED BY DOOR (ARCH) #";I
 225   PRINT "WILL HAVE TO BE CONSIDERED PART OF "
 230   PRINT "THE TARGET ROOM FOR THE FOLLOWING CALCULATIONS"
 235   GOTO 250
 240   S1=S1+X*300
 245   S2=S2+X*200
 250 NEXT I
 255 PRINT
 260 FOR J=1 TO 8
 265   W(J)=0
 270   PRINT
 275   PRINT "HOW MANY WINDOWS IN THE ROOM FACE ";C$(J);
 280   INPUT N
 285   IF N=0 THEN 425
 290   FOR I=1 TO N
 295     PRINT "WIDTH,HEIGHT FOR WINDOW #";I
 300     INPUT X,Y
 305     PRINT "DOES THE WINDOW HAVE (SELECT #):"
 310     PRINT "    1. NO SHADES OR AWNINGS"
 315     PRINT "    2. INSIDE SHADES "
 320     PRINT "    3. AWNINGS"
 325     PRINT "    4. BOTH"
 330     INPUT K
 335     IF K<1 OR K>4 THEN 305
 340     IF K=4 THEN LET K=3
 345     PRINT "IS THE WINDOW GLASS BLOCK";
 350     INPUT I$
 355     IF I$(1,1)<>"Y" THEN 375
 360     LET F=.5
 365     W2=W2+X*Y
 370     GOTO 415
 375     PRINT "IS THE WINDOW DOUBLE GLASS OR A STORM WINDOW";
 380     INPUT I$
 385     IF I$(1,1)<>"Y" THEN 405
 390     LET F=.8
 395     W2=W2+X*Y
 400     GOTO 415
 405     W1=W1+X*Y
 410     LET F=1
 415     LET W(J)=W(J)+X*Y*Q(J,K)*F
 420   NEXT I
 425 NEXT J
 430 LET B=W(1)
 435 FOR J=2 TO 8
 440   IF B<W(J) THEN B=W(J)
 445 NEXT J
 450 T=W1*14+W2*7
 455 S1=S1+B+T
 460 S2=S2+T
 465 PRINT
 470 PRINT "ARE THE OUTSIDE WALLS OF THE ROOM (SELECT#)"
 475 PRINT "1. UNINSULATED FRAME OR MASONRY < 8 INCHES THICK"
 480 PRINT "2. INSULATED OR MASONRY > 8 INCHES THICK"
 485 INPUT K
 490 IF K<>1 AND K<>2 THEN 470
 495 PRINT "WHAT IS THE LENGTH OF ALL NORTHERN EXPOSURE WALLS";
 500 INPUT X
 505 PRINT "WHAT IS THE LENGTH OF ALL OTHER OUTSIDE WALLS"
 510 PRINT "   SHADED BY ADJACENT BUILDINGS";
 515 INPUT Y
 520 PRINT "WHAT IS THE LENGTH OF ALL REMAINING OUTSIDE WALLS";
 525 INPUT Z
 530 LET S1=S1+R(1,K)*(X+Y)+R(2,K)*Z
 535 LET S2=S2+R(3,K)*(X+Y+Z)
 540 PRINT "WHAT IS THE LENGTH OF ALL WALLS BETWEEN THIS AND "
 545 PRINT "   ANY UNCOOLED ROOMS";
 550 INPUT X
 555 LET S1=S1+30*X
 560 LET S2=S2+30*X
 565 PRINT
 570 PRINT "IS THE ROOM CEILING (SELECT#)"
 575 PRINT "1. UNINSULATED WITH NO SPACE ABOVE"
 580 PRINT "2. INSULATED WITH NO SPACE ABOVE"
 585 PRINT "3. UNINSULATED WITH ATTIC OR CRAWL SPACE ABOVE"
 590 PRINT "4. INSULATED WITH ATTIC OR CRAWL SPACE ABOVE"
 595 PRINT "5. OCCUPIED SPACE ABOVE"
 600 INPUT K
 605 IF K<1 OR K>5 THEN 570
 610 PRINT "ENTER THE WIDTH AND LENGTH OF CEILING"
 615 INPUT X,Y
 620 LET S1=S1+U(K,1)*X*Y
 625 LET S2=S2+U(K,2)*X*Y
 630 PRINT
 635 PRINT "IS THE ROOM FLOOR DIRECTLY ON THE GROUND"
 640 PRINT "OR OVER A BASEMENT (Y OR N)";
 645 INPUT I$
 650 IF I$(1,1)="Y" THEN 675
 655 PRINT "ENTER FLOOR WIDTH,LENGTH";
 660 INPUT X,Y
 665 S1=S1+3*X*Y
 670 S2=S2+3*X*Y
 675 PRINT
 680 PRINT "ENTER YOUR CLIMATE FACTOR IF YOU CAN OBTAIN IT"
 685 PRINT "(ELSE ENTER 0)";
 690 INPUT X
 695 IF NOT (X=0 OR X>1.1 OR X<.9) THEN 850
 700 PRINT "WE CAN TRY AND ESTIMATE YOUR CLIMATE FACTOR"
 705 PRINT "DO YOU LIVE IN THE NEW ENGLAND STATES,WASHINGTON,"
 710 PRINT "   NORTHERN OREGON, MONTANA, IDAHO, WYOMING, UTAH,"
 715 PRINT "   N. DAKOTA, WESTERN COLORADO, WESTERN S. DAKOTA,"
 720 PRINT "   NORTHERN MINNESOTA, OR NEW YORK (EXCEPT THE"
 725 PRINT "   NEW YORK CITY AREA)";
 730 INPUT I$
 735 IF I$(1,1)<>"Y" THEN 750
 740 X=.95
 745 GOTO 835
 750 PRINT "DO YOU LIVE IN EASTERN TEXAS, EASTERN OKLAHOMA,"
```

```
755 PRINT "    LOUISIANA, ARKANASA, FLORIDA, OR THE SOUTHERN"
760 PRINT "    HALVES OF MISSISSIPPI, ALABAMA OR GEORGIA";
765 INPUT I$
770 IF I$(1,1)<>"Y" THEN 785
775 X=1.05
780 GOTO 835
785 PRINT "DO YOU LIVE IN THE AREA OF PHOENIX OR TUCSON"
790 PRINT "    OR IN CALIFORNIA IN OR SOUTHEAST OF FRESNO";
795 INPUT I$
800 IF I$(1,1)="Y" THEN 775
805 PRINT "DO YOU LIVE IN LAS VEGAS OR DUE SOUTH OF IT";
810 INPUT I$
815 IF I$(1,1)<>"Y" THEN 830
820 X=1.1
825 GOTO 835
830 X=1
835 PRINT
840 PRINT USING 845;X
845 IMAGE "YOUR CLIMATE FACTOR IS ESTIMATED AS ",0.00
850 S1=S1*X
855 S2=S2*X
860 PRINT
865 PRINT "HOW MANY PEOPLE WILL NORMALLY OCCUPY THE ROOM";
870 INPUT X
875 IF X<2 THEN LET X=2
880 S1=S1+X*600
885 S2=S2+X*600
890 PRINT
895 PRINT "WHAT IS THE TOTAL WATTAGE OF ALL ELECTRICAL "
900 PRINT "    EQUIPMENT AND LIGHTS IN THE ROOM (NOT INCLUDING"
905 PRINT "    THE AIR CONDITIONER ITSELF";
910 INPUT X
915 IF X<0 THEN 895
920 S1=S1+X*3
925 S2=S2+X*3
930 PRINT
935 PRINT "*************************************************"
940 PRINT "THE BTU/HOUR COOLING LOAD IS"
945 PRINT "    FULL-TIME USE =";S1
950 PRINT "        CHOOSE A UNIT IN THE RANGE OF ";INT(1.1*S1)
955 PRINT "            TO ";INT(.9*S1);"BTU/HOUR"
960 PRINT "    NIGHTS ONLY =";S2
965 PRINT "        CHOOSE A UNIT IN THE RANGE OF ";INT(1.1*S2)
970 PRINT "            TO ";INT(.9*S2);"BTU/HOUR"
975 PRINT "*************************************************"
980 PRINT
985 PRINT "DO YOU WISH TO ESTIMATE COOLING COSTS FOR SPECIFIC MODELS";
990 INPUT I$
995 IF I$(1,1)<>"Y" THEN 1085
1000 PRINT "ENTER YOUR ELECTRIC RATE IN CENTS/KILOWATT-HOUR";
1005 INPUT X
1010 IF X>1 THEN 1025
1015 PRINT "ARE YOU SURE THAT'S IN CENTS/KILOWATT-HOUR?"
1020 GOTO 1000
1025 PRINT "ENTER THE AVERAGE NUMBER OF COOLING HOURS/SEASON";
1030 INPUT Y
1035 LET Z=S1*X*Y*.00001
1040 PRINT
1045 PRINT "ENTER THE EER (ENERGY EFFICIENCY RATIO) FOR THE"
1050 PRINT "    AIR CONDITIONER (ENTER 0 TO STOP)";
1055 INPUT X
1060 IF X<=0 THEN 1085
1065 LET Y=Z/X
1070 PRINT USING 1075;Y
1075 IMAGE "APPROXIMATE ANNUAL COST OF OPERATION (DAYS & NIGHTS)",$DDD.&
DD
1080 GOTO 1040
1085 PRINT
1090 PRINT "END OF RUN*******"
1095 STOP
1100 DATA "NORTHEAST","EAST","SOUTHEAST","SOUTH"
1105 DATA "SOUTHWEST","WEST","NORTHWEST","NORTH"
1110 DATA 60,25,20,80,40,25,75,30,20,75,35,20
1115 DATA 110,45,30,150,65,45,120,50,35,0,0,0
1120 DATA 30,20,60,30,30,20
1125 DATA 19,5,8,3,12,7,5,4,3,3
1130 END
```


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SYSTEM DOCTOR does a thorough diagnostic check of your entire computer system. It lets you know if something is wrong before you spend time programming or entering data. The program checks the ROM to ensure that every bit is functional and checks the RAM six different ways. The disk drives are tested in a variety of ways to ensure reliability. The cassette recorder is also tested for speed, volume and distortion with the help of a calibration tape provided with the program. The video memory and display are also checked as well as the line printer. **SYSTEM DOCTOR** also does a 12-hour check of the entire system and records the results on tape, disk or the screen. As a bonus, this program also includes the **DISK DRIVE HEAD CLEANER.** The card insert that cleans the head can be obtained free by mailing in the coupon provided. For $28.50, **SYSTEM DOCTOR** is the first complete diagnostic program for the TRS-80. A disk version is available for $38.50.

LINE PRINTER by Dosse Segbeaya is a machine language program that accelerates printing on Centronics printers by making it a background task. Requiring 32K and a disk drive, this program enables the user to set aside up to 16K of memory as buffer which when filled is sent to the line printer while your Basic program continues to run. Any Basic program that uses LPRINT's will run significantly faster with this program. Also included is the ability to set the number of characters per line, the number of lines per page, the spaces between lines, and the left, top and bottom margins. Page numbers can be placed anywhere on the first line starting at any given number. Printouts of anything that is on the screen can also be made by hitting shift/break. If you do programming and you use multistatement lines, **LINE PRINTER** enables you to LLIST your program with single statement lines. This rather amazing program is resident in high memory as it interfaces with almost any Basic program. It sells on disk for $24.50.



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Multifarious Cassette Interface

This cassette interface is inexpensive, fast and reliable.

Would you like an inexpensive, yet highly reliable, cassette interface system capable of data-transmission rates around 200 bytes per second? If so, this article is for you. It describes a system that uses the popular biphase recording method (Tarbell) but performs the encoding and decoding in software. This results in a simple and inexpensive (about $2) cassette hardware interface. Yet the performance is virtually identical to systems employing this method entirely in hardware.

Background

Prior to this system, I used a simple, non-speed-independent 300 baud Kansas City Standard cassette interface. While this system did work, its reliability was marginal at best. I do not know whether this was due to the inexpensive tape recorder, the brand of tape or the simplicity of the interface. However, I soon started looking for a better system. In addition, 300 baud is quite slow.

While reviewing past articles on cassette interfaces, I came across an article on making a Tarbell-type interface operational ("How to Get Your Tarbell Going," by Larry Weinstein, *Byte*, July 1978). In addition to detailed information on the biphase method used in that interface, the details of the critical audio-to-digital interface circuits were provided. I was surprised at the simplicity of these interfaces. Only a handful of components are needed to convert the TTL levels of a single bit I/O port to audio and vice versa.

It seemed that if these apparently highly reliable, yet simple, circuits were duplicated and interfaced to the TTL input and output ports on my computer and the logic performed in software, the performance of the tape system would be OK. The system described verified these expectations.

```
0000                    0200 ;
0000                    0220 ; OUTPUT ROUTINE
0000                    0240 ; OUTPUTS BYTE IN ACC
0000                    0260 ; ALL REGISTERS PRESERVED
0000                    0280 ;
0000 C5                 0300 TAPOUT   PUSH   B       SAVE REGS
0001 D5                 0320          PUSH   D
0002 F5                 0330          PUSH   PSW
0003 57                 0340          MOV    D,A     BYTE TO BE SENT
0004 0E 08              0360          MVI    C,8     8 BITS
0006 7A                 0365 LOOPO    MOV    A,D     GET BYTE
0007 07                 0370          RLC            ROTATE IT
0008 57                 0375          MOV    D,A     SAVE IT
0009 3E 01              0380          MVI    A,1     CLOCK=1
000B AA                 0400          XRA    D       CLOCK XOR BIT
000C D3 01              0420          OUT    1       OUTPUT IT
000E CD 21 00           0440          CALL   TIMED   WAIT HALF CYCLE
0011 3E 00              0460          MVI    A,0     CLOCK=0
0013 AA                 0480          XRA    D       CLOCK XOR BIT
0014 D3 01              0500          OUT    1       OUTPUT IT
0016 CD 21 00           0520          CALL   TIMED   WAIT HALF CYCLE
0019 0D                 0580          DCR    C       ALL BITS SENT?
001A C2 06 00           0600          JNZ    LOOPO   LOOP IF NOT
001D F1                 0630          POP    PSW
001E D1                 0640          POP    D
001F C1                 0660          POP    B
0020 C9                 0680          RET
0021 06 44              0700 TIMED    MVI    B,68
0023 05                 0720          DCR    B       DELAY COUNT ZERO?
0024 C2 23 00           0740          JNZ    TIMED+2 WAIT IF NOT
0027 C9                 0760          RET
```

Listing 1. Output routine.

Hardware

Even though the unique aspect of this system is the encoding and decoding of the tape signals with software, the necessary, yet simple, components required to interface with the computer are shown here. These circuits are based on those shown in the referenced article.

Shown in Fig. 1 is the computer output port-to-tape interface, which is driven by a normal TTL (latched) single bit output port. Note that it is a simple low-pass filter with a voltage divider to make the levels compatible with those required by the microphone input of the tape recorder. If you use a high-level (often termed "aux") input (I did not), the voltage divider R1/R2 may not be required.

Fig. 2 shows the tape-to-computer interface. Its purpose is

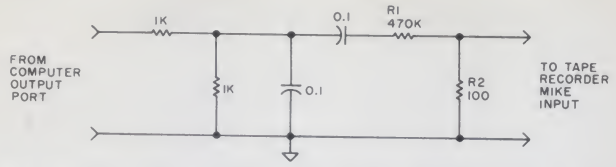


Fig. 1. Computer-to-tape interface. (Note: resistors are in Ohms; capacitors are in uF.)

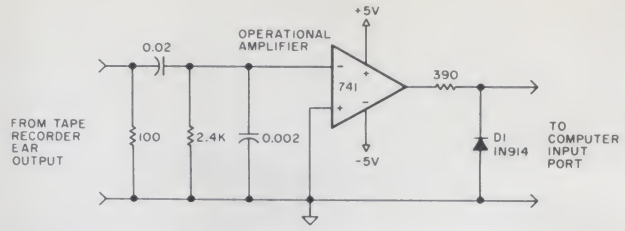


Fig. 2. Tape-to-computer interface.

to convert the audio signal into a rectangular-shaped wave, which is then sampled by the computer's input port.

As you can see, the circuit is essentially the same as that used in the Tarbell using an inexpensive operational amplifier. Although the simple hysteresis circuit of the Tarbell could easily be added, Weinstein recommended eliminating it. In the interest of simplicity, this was done with excellent results. Since the output of the operational amplifier varies between positive and negative voltages and my computer input port is a TTL IC, which requires positive-only levels, the negative output voltages are limited by diode D1.

Software

Shown in Listings 1 and 2 are 8080 assembly-language routines for the output and input code, respectively. To use the output routine, simply call it with the byte to be sent in the accumulator. All registers are preserved. To use the input routine, call it first with 255 decimal in the accumulator (actually any negative number). This informs the routine to look for the synchronization byte (0E6H).

When it is found, the next eight bits are returned to the calling routine in the accumulator. Thereafter, the routine is called with an 8 in the accumulator. Each set of eight bits will be returned. Except for the accumulator (which will have the data) and flags, all registers are preserved.

The routine automatically takes care of the problem of data inversion (common to all biphase systems) by checking initially for both the sync byte and its complement. A flag is set and is used thereafter to complement the resulting data if necessary. Since the routines use preset timing loops for generation of the synchronous data, there must not be excessive time (less than 150 microseconds) between successive subroutine calls. See Listing 3 for a typical use.

A description of the routines follows, while flowcharts are shown in Figs. 3 and 4. For output (Listing 1), each bit of the data is exclusive ORed with a clock created with a timing loop. The data byte is rotated (lines 365-375) and exclusive ORed (lines 400 and 480) with the clock created with the timing loop in lines 700-760.

This timing loop determines the half period (333 usec) of the basic output frequency (1500 Hz). The time-determining constant in this loop (line 700) must be adjusted to produce this half period. For a Z-80 processor with a 4 MHz clock using one wait state memory, the constant is 68 as shown. For an 8080 processor with a 2 MHz clock and no wait states, the constant is 40. For other processors, clock rates and memory speeds, the constant must be adjusted accordingly.

To use the output routine, simply call it with the byte to be sent in the accumulator. Of course, since this is a synchronous data-transmission method, the first data byte

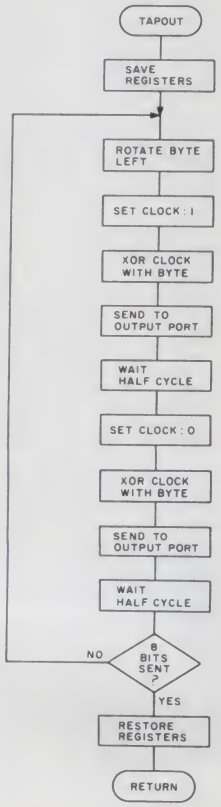


Fig. 3. Output routine flowchart.

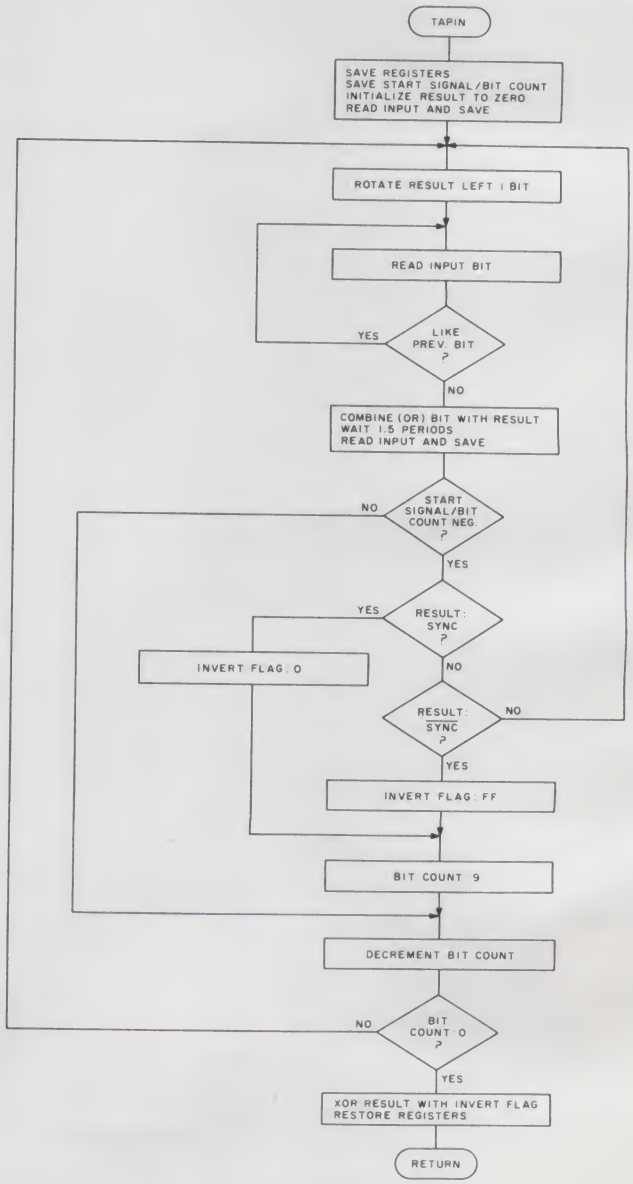


Fig. 4. Input routine flowchart.

must be preceded by a synchronization byte, in this case 0E6H. In addition, some kind of additional byte must precede the synchronization byte.

The input routine logic is more complex (see Listing 2 and Fig. 4). First, after the routine is called and a result register (C) is initialized, the input is repeatedly sampled to determine an input transition. After this occurs, the input bit is ORed (line 2280) with the result that has been rotated one bit previously (line 2155). Next, a delay of 1.5 half cycles of the basic frequency (1500 Hz) is inserted. This is required to maintain synchronization even if the tape speed varies. Its function is the same as a monostable multivibrator in hardware implementations of this method of decoding.

After a bit has been decoded, a test is made to see if synchronization has been previously achieved. If the routine was called with a positive number in the accumulator, the routine will assume synchronization, and the decoding process just described will be repeated until all eight bits are received. Depending upon the state of the Invert flag, the data is complemented to compensate for any data-phase inversions occurring during the recording/playback process. The routine then returns with the result.

In the event that the input routine was called with a negative number in the accumulator, a comparison is performed after each bit is received to see if the synchronization byte (0E6H) or its complement is received. If not, the routine continues to read input bits looking for a sync byte. When it is found, the Invert flag is appropriately set (lines 2512 and 2532), a flag is set indicating synchronization (line 2560) and operation proceeds to decode the next eight bits as described in the preceding paragraph. As in the output routine, a timing loop (lines 2800-2860) is used to control the frequency of operation.

For the input routine, the delay should be set to 1.5 times the half period (1.5 × 333 usec) of the basic frequency. The value of 102 shown in the listing is for a 4 MHz Z-80 with one wait state, while a value of 60 would be used for an 8080 with no wait states. Note also that the Invert flag must be located in some convenient location in RAM.

Operation

The use of this system of hardware/software implementation of the biphase method is similar to that of a hardware-only system. Listing 3 shows a simple use of the system to save and then load a block of memory. After the start byte and sync byte are sent, each byte is sent by calling with the desired byte in the accumulator.

As noted in the section on the hardware interface, the level to the tape recorder must be within the acceptable input range. For my inexpensive tape recorder with automatic level control, this does not appear critical and is the same level used with any type of audio recording of data.

Similarly, the playback level must be an acceptable value. To set the playback level, a test tape consisting of a long series of consecutive sync bytes (0E6H) was first recorded. Next, this was played back, and the output of the operational amplifier in Fig. 2 was monitored on an oscilloscope. If the volume is set too low, the output level will not switch reliably. If it is set too high, noise pulses will be seen intermixed with the desired data, which should appear as a clean, rectangular wave. After determining the playback setting, which does not appear critical, the recorder is simply set at that point each time.

If an oscilloscope is not available, some other means of displaying when a sync byte is received must be used (such as moving a cursor in a video display), and the playback volume must be adjusted to produce reliable results.

Performance

In my experience, using inexpensive tape and an inexpensive tape recorder (see next section) with this system provides excellent reliability. I normally use the standard Tarbell rate of about 187 bytes/sec at a (software) clock rate of 1500 Hz and almost never get an error.

Weinstein's article included a test program for use with evaluating a Tarbell interface. It consists of recording and then playing back a long series of alternating bytes consisting of 0E6H (the sync byte) and 22H (which Weinstein says is a critical byte easily missed). I

```
0028                    2000 *
0028                    2020 * INPUT ROUTINE
0028                    2040 *
0028                    2060 *
0028                    2070 SYNC       EQU     0E6H
0028                    2075 INVERT     EQU     3FH     INVERT FLAG STORED HERE
0028 C5                 2080 TAPIN      PUSH    B       SAVE REGS
0029 D5                 2100            PUSH    D
002A 0E 00              2120            MVI     C,0     RESULT
002C 57                 2130            MOV     D,A     START SIGNAL
002D DB 01              2135            IN      1
002F 5F                 2140            MOV     E,A
0030 79                 2145 LOOPI      MOV     A,C     RESULT SO FAR
0031 E6 7F              2150            ANI     127     BE SURE UPPER BIT=0
0033 07                 2155            RLC             ROTATE RESULT
0034 4F                 2160            MOV     C,A     REPLACE RESULT
0035 DB 01              2180 CHANGE     IN      1       INPUT DATA BIT
0037 BB                 2200            CMP     E       LIKE PREV. BIT?
0038 CA 35 00           2220            JZ      CHANGE  YES-LOOP
003B E6 01              2260            ANI     1       1 BIT ONLY
003D B1                 2280            ORA     C       COMBINE WITH PREV RESULT
003E 4F                 2320            MOV     C,A     RESULT
003F CD 6E 00           2340            CALL    TIMEI   WAIT 1.5 PERIODS
0042 DB 01              2360            IN      1       READ INPUT
0044 5F                 2380            MOV     E,A
0045 7A                 2400            MOV     A,D
0046 B7                 2420            ORA     A       SYNC BYTE ALREADY FOUND?
0047 F2 63 00           2440            JP      STARTED YES
004A 79                 2460            MOV     A,C     BYTE SO FAR
004B FE E6              2500            CPI     SYNC    SYNC BYTE?
004D C2 57 00           2504            JNZ     TRYIN   TRY INVERT TEST
0050 AF                 2508            XRA     A       CLEAR ACC
0051 32 3F 00           2512            STA     INVERT  SET INVERT FLAG
0054 C3 61 00           2516            JMP     STARTED-2       SYNC FOUND
0057 FE 19              2520 TRYIN      CPI     -SYNC-1 CHECK SYNC COMP
0059 C2 30 00           2524            JNZ     LOOPI   NO MATCH KEEP LOOKING
005C 3E FF              2528            MVI     A,0FFH  INVERT FLAG
005E 32 3F 00           2532            STA     INVERT  STORE IT
0061 16 09              2560            MVI     D,9     8 BITS+1
0063 15                 2600 STARTED    DCR     D       BITS/BYTE
0064 C2 30 00           2620            JNZ     LOOPI   CONTINUE IF NZ
0067 3A 3F 00           2680            LDA     INVERT  INVERT FLAG
006A A9                 2685            XRA     C       INVERT OP NOT RESULT
006B D1                 2740            POP     D
006C C1                 2760            POP     B
006D C9                 2780            RET
006E 06 66              2800 TIMEI      MVI     B,102
0070 05                 2820            DCR     B       LOOP COUNT
0071 C2 70 00           2840            JNZ     TIMEI+2 LOOP IF NOT DONE
0074 C9                 2860            RET
```

Listing 2. Input routine.

followed this procedure repeatedly, recording over 100,000 bytes on different tapes. When I played back the tape, I noticed no errors. (In fact, this is a good way to check the quality of a new tape.)

This successful result caused me to wonder how fast the rate could be increased before an unacceptable loss in reliability occurred. This was easily implemented by reducing the timing loop constants proportionally.

At a clock rate of 3000 Hz (about 375 bytes/sec), the system described worked very well with no apparent loss in reliability (over 100,000 sequential bytes). However, with my inexpensive system, a clock rate of 6000 Hz (750 bytes/sec) did not work.

Cassette Tape Brand and Recorder Comments

I have often read statements in articles on cassette recording stating that a high quality tape be used. That I used both an inexpensive recorder and inexpensive tape may be of interest to others contemplating the purchase of tape or a recorder.

I mainly used the most inexpensive tape sold by Radio Shack—Concertape in C-30 size cassettes. Although I have no information as to its audio quality, I almost never lose a bit of data. Perhaps this is due to the simplicity and reliability of this recording method. At any rate, at three cassettes for $2, it has to be a "best buy."

I have recently also used inexpensive Irish brand tape (type 261) sold at a local discount department store. It also performs well.

I used an inexpensive Panasonic model RQ-309, an approximately $40 recorder. I have two of these machines, which, when used with this cassette-recording method, perform reliably.

Disadvantage

Perhaps the only disadvantage of this cassette-recording system is that the routines must first reside in the computer. Even 100 bytes plus a simple loader is too much to enter each time by hand. I solved the problem by including the routines in a 2708 EPROM along with my basic operating system routines. Thus the cassette routines are always available for use.

Conclusions

The use of the biphase recording technique is a reliable, fast, cassette-recording system, even when used with an inexpensive brand of tape and an inexpensive recorder. Furthermore, you can easily implement the technique in less than 120 bytes of software with only a minimal amount of hardware to interface with the recorder.■

```
0075                    5000 *
0075                    5010 * ROUTINE TO DEMONSTRATE SIMPLE USE OF TAPE OUTPUT
0075                    5020 * ROUTINE
0075                    5040 *
0075 21 00 00           5050          LXI     H,0     STARTING ADDRESS
0078 01 40 00           5060          LXI     B,40H   NUMBER OF BYTES
007B AF                 5070          XRA     A       CLEAR ACCUMULATOR
007C CD 00 00           5080          CALL    TAPOUT  WRITE BYTE
007F 3E E6              5090          MVI     A,0E6H  SYNC BYTE
0081 CD 00 00           5100          CALL    TAPOUT  WRITE IT
0084 7E                 5110 LOOP1    MOV     A,M     GET BYTE TO WRITE
0085 CD 00 00           5120          CALL    TAPOUT  WRITE IT
0088 23                 5125          INX     H       BUMP ADDRESS
0089 0B                 5130          DCX     B       DECREMENT COUNT
008A 78                 5140          MOV     A,B     IS
008B B1                 5150          ORA     C          COUNT=0?
008C C2 84 00           5160          JNZ     LOOP1   NO-KEEP WRITING
008F C9                 5170          RET             RETURN TO CALLER
0090                    5180 *
0090                    5190 *
0090                    5200 *        SIMPLE ROUTINE TO DEMONSTARTE USE OF
0090                    5210 *        BYPHASE TAPE INPUT ROUTINE
0090                    5220 *
0090 21 00 3F           5230          LXI     H,3F00H STARTING ADDRESS
0093 01 40 00           5240          LXI     B,40H   NUMBER OF BYTES
0096 3E FF              5250          MVI     A,255   TO SIGNAL -LOOKFOR SYNC
0098 CD 28 00           5260 LOOP2    CALL    TAPIN   GET BYTE
009B 77                 5270          MOV     M,A     STORE IT
009C 23                 5280          INX     H       BUMP ADDRESS
009D 0B                 5290          DCX     B       DECREMENT COUNT
009E 78                 5300          MOV     A,B     IS
009F B1                 5310          ORA     C          COUNT=0?
00A0 3E 08              5320          MVI     A,8     TO SIGNAL SYNC ALREADY F
00A2 C2 98 00           5330          JNZ     LOOP2   LOOP FOR MOR BYTES
00A5 C9                 5340          RET             RETURN TO CALLER
```

Listing 3. Demonstration program showing typical use of routines.

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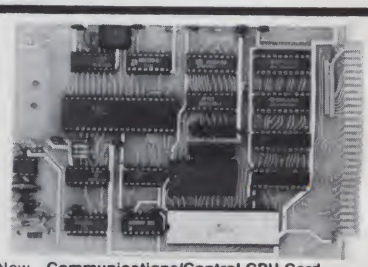
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PET I/O Port "Expander"

Add-ons tie up user ports. This author found one way to solve the problem.

William F. Pytlik
9012 Maritime Ct.
Springfield VA 22153

Home computers have satisfied initial demands for data analysis, bookkeeping and game playing but have also created a tremendous ground-swell demand for "gee-whiz" peripherals for these computers. Magazine letter columns were deluged with requests for devices from joysticks to controllers for a home-sprinkler system. Recently, these requests have been answered with a flood of computer add-on devices. Unfortunately, each of these devices ties up one of the precious few user ports on the home computer.

This is a real problem on my PET since only one user port is available. Worse yet, I have often found myself leaning over my PET, using alligator clips to tie into the I/O port during experimentation. This is not only inconvenient, but also potentially damaging to the computer (shorted leads, etc.). Experimentation required a separate power supply and a jungle of wires, leaving little room for test equipment.

To resolve the problem I decided to build an I/O port "Expander"—fully regulated +5, ±15 volt power supplies, I/O port status indicator, front-panel inputs to the I/O port, a duplicate of the PET's user port and a motherboard with provisions for six daughterboards provide broad flexibility and utility. Consequently, the hobbyist or engineer/technician can design and test a series of modules and simply plug them into the motherboard. Photo 1 illustrates the basic Expander.

The hardware described is for a PET 2001-8 computer but is general enough to be applied, with minor modifications, to any computer with a parallel port.

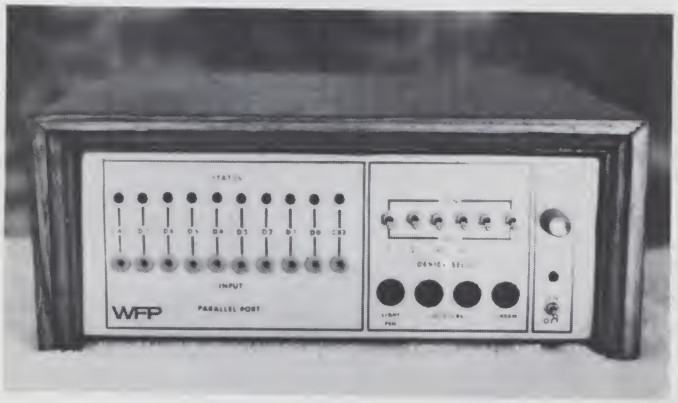




Photo 1. The I/O port Expander.

Motherboard

The heart of the Expander is a single printed circuit motherboard. Photo 2 presents an illustration of the motherboard as assembled in the Expander, while Fig. 1 presents a pattern for the board.

The left portion of the board is the power supply. Bridge, filter capacitors and ±15 volt regulators are mounted on the board. The +5 volt regulator is mounted on the chassis. Since large ±15 volt loads are not anticipated, heat sinks are not used on these regulators.

The edge connectors are 25/50-pin connectors with 0.1 inch spacing. I chose these so that a person unable to use photographic techniques in printed circuit (PC) construction could use simple 0.1 inch grid predrilled PC boards. The circuit pattern can simply be drawn on such PC boards with a resist pen. The holes are already drilled. Alternative use of 0.125 or 0.156 inch spacing edge connectors precludes the use of such predrilled PC boards.

Chassis

The chassis is often the most expensive component of many electronic projects. A chassis that meets specific project requirements is often difficult to find at any cost. Consequently, I decided some time ago to fabricate my own. Actually, it is quite simple, and even the beginner

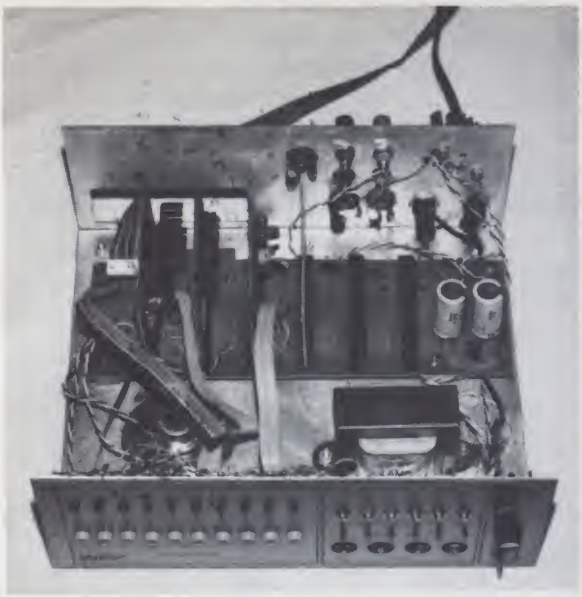


Photo 2. Expander printed circuit motherboard.

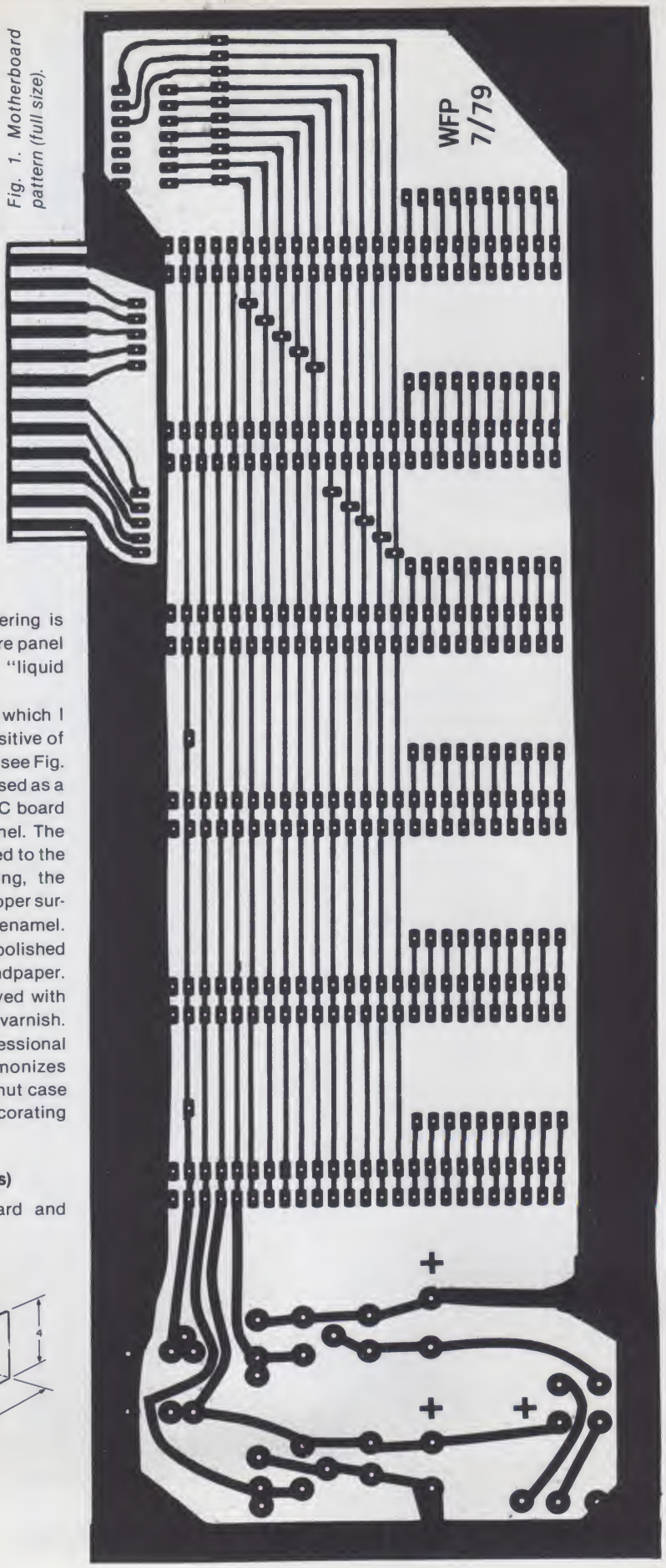


Fig. 1. Motherboard pattern (full size).

should not be discouraged from building his own.

The easiest method is to construct the chassis from three sheets of aluminum—the front, back and bottom. Fig. 2 illustrates the chassis used in this project. The aluminum may be obtained at a local sheet-metal shop, which may also cut and bend the metal at a nominal charge. By using three pieces, you can simplify the drilling and preparation of the front and back panels.

To add the professional touch (and prevent your wife from throwing out an amateurish, cheap-looking chassis), you can add a walnut case and professional-looking front panel. The front panel can be constructed in a variety of ways. In one method, the front panel is drilled and polished with an orbital sander using 200-400 grit sandpaper. Dry transfer lettering is then added, and the entire panel is coated with satin "liquid plastic" spray varnish.

The second method, which I used, requires that a positive of the front panel be made (see Fig. 3). This positive is then used as a negative to prepare a PC board the size of the front panel. The board is etched and glued to the front panel. After drilling, the legend (etched in the copper surface) is filled with black enamel. When dry, the panel is polished with 200-400 grit sandpaper. The panel is then sprayed with satin "liquid plastic" varnish. The result is a truly professional front panel that harmonizes beautifully with the walnut case and, of course, any decorating scheme.

Assembly (Main Chassis)

Once the motherboard and

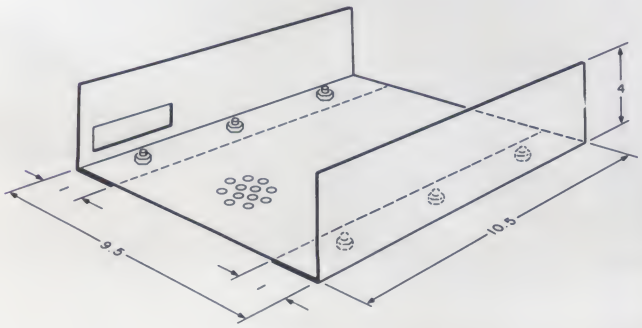


Fig. 2. Chassis dimensions.

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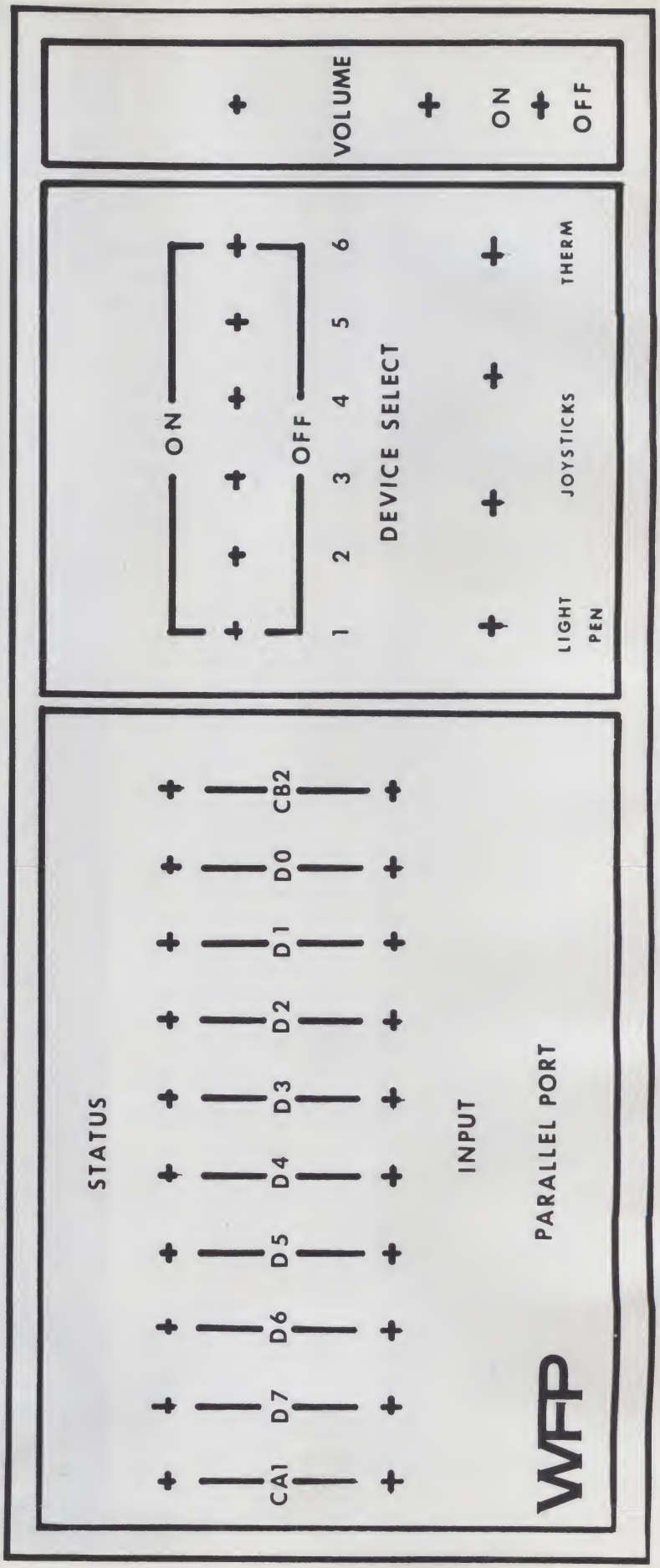


Fig. 3. The front panel (full size).

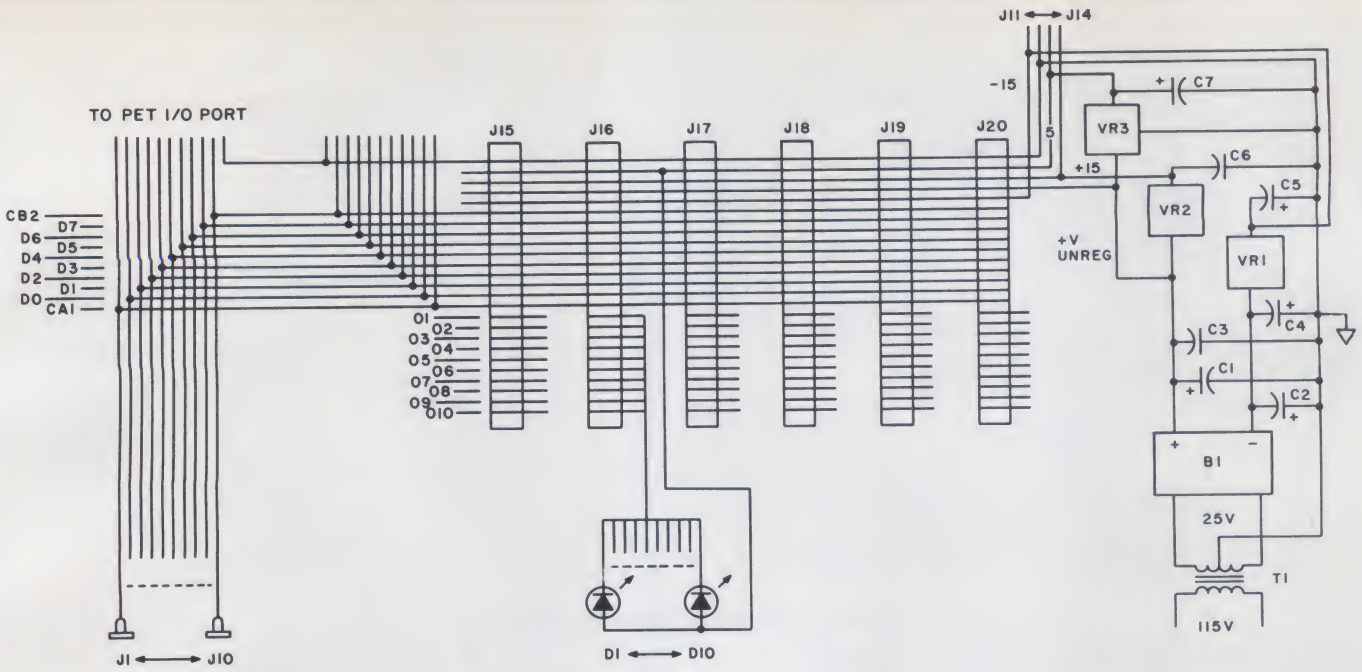


Fig. 4. Wiring diagram.

chassis are completed, install front-panel switches, DIN connectors for device inputs, volume control, light emitting diodes (LEDs)—these are simply glued in—and input TIP jacks. On the back panel install banana jacks (power-supply outputs), phone jacks (other inputs/outputs), +5 volt regulator and heat sink and fuse holder. On the bottom of the chassis mount the motherboard, transformer and speaker. Add rubber feet to complete the chassis. Wire power supply, LEDs, TIP jacks, switches and I/O jacks as shown in Fig. 4.

I/O Port Status Indicator Module

It is often desirable, if not necessary, to observe operation of the I/O port. This is especially useful during experimentation or engineering development.

The basic indicator circuitry is mounted on a 3 × 4 inch printed circuit board constructed to plug into the motherboard. The LEDs have already been installed during building of the basic Expander. The schematic in Fig. 5 should be used during assembly of the module, while Fig. 6 presents a full-size pattern of the printed circuit board. Photo 3 shows the completed module.

The circuit is simple. The LEDs are buffered by MOS buffers (IC1 and IC2), which present a negligible load to the I/O port and, consequently, do not interfere with any I/O port opera-

B1	—	50 piv 2 Amp Bridge Rectifier
D1-D10	—	Light Emitting Diodes
C1,C2	—	3300 μF 25 V Capacitor
C3	—	.33 μF
C4	—	2.2 μF tantalum Capacitor
C5,C7	—	1 μF tantalum Capacitor
C6	—	.1 μF
J1-J10	—	TIP Jacks (front panel)
J11-J14	—	Banana Jacks (rear panel)
J15-J20	—	25/50 Pin 0.1 inch Edge Connectors
IC1-IC2	—	CD4050 hex Buffer
IC3-IC4	—	SN7406 hex Inverter—Open Collector
J21-J24	—	DIN Jacks (front panel)
R1-R10	—	180 Ohm ¼ Watt Resistor
T1	—	25 VCT Transformer
VR1	—	LM7915T −15 Volt Regulator
VR2	—	LM7815T +15 Volt Regulator
VR3	—	LM309K +5 Volt Regulator
S1-S7	—	SPST Toggle
SP1	—	2½" 8Ω Speaker
MISC	—	Hardware, ribbon cable, jacks, etc.

Parts list.

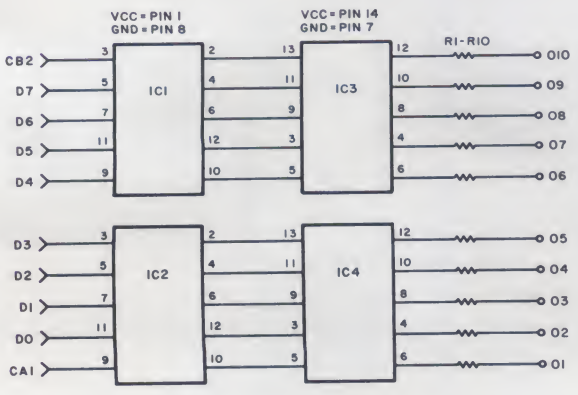


Fig. 5. Assembling the module.

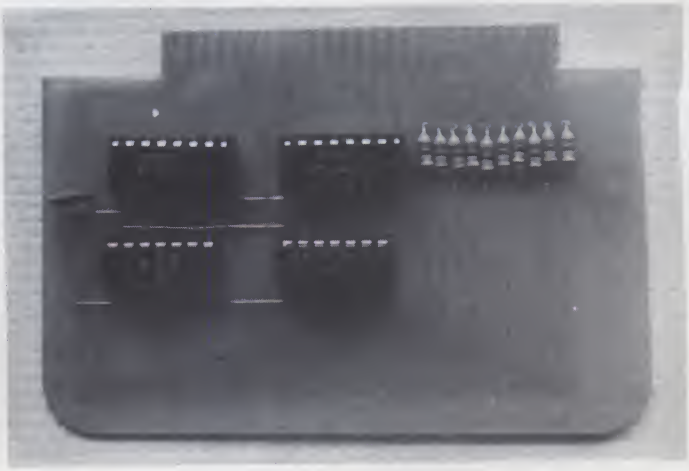


Photo 3. I/O port status indicator module.

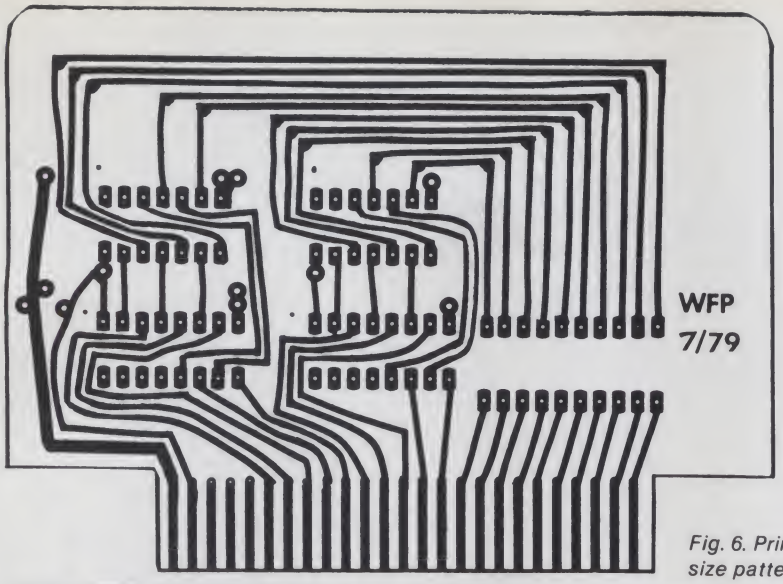


Fig. 6. Printed circuit board (full-size pattern).

tions.

Visual indication often makes design of experimental circuits simple. The I/O port status indicator module, in conjunction with the Expander, may be used to check out I/O port inputs without being tied to the computer. This is a valuable development aid.

This completes the basic Expander chassis, which is now ready to serve as a power supply or, by use of front-panel TIP jacks, an input/output experimentation port. The Expander is also ready to accept a variety of plug-in modules, which enhance the utility of any home computer. ■

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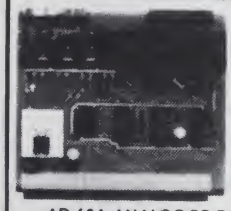
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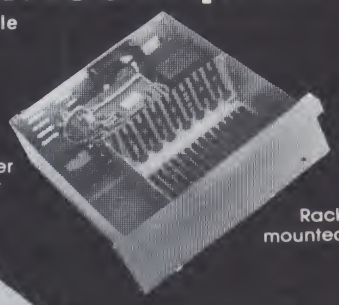
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Dial-up Directory

For his sixth installment, Dialer Derfler looks at practical problems in communicating, spotlights a specialized bulletin system and introduces PAN, a computer mail system.

Frank J. Derfler, Jr.
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Many people have discovered the concise and convenient communications they can have with a computer and the telephone. This month we will discuss some practical problems in communicating, spotlight a specialized electronic bulletin system and introduce you to PAN.

Troubleshooting

I have been receiving much mail —both paper and electronic—asking for help (remember to include a stamped, return envelope if you use paper mail). Problems range from the inability to hook up modems to cassette ports (it can be done, but usually is not) to parts that emit smoke when the unit is plugged in.

The biggest problems, however, are intermittent problems, which have always been the curse of electronics technicians. The situation is made more difficult by the various bits and pieces we fit together to make a smart terminal. In the case of intermittent operation, I almost always suspect the modem and phone line area first, but let's review all of the possible areas.

Bits and Pieces

Unless you are using a well-integrated system such as the D.C. Hayes and the Apple II, you probably have added several independent items to your computer: a software package to allow the system to behave as a terminal and write and read files while communicating; an RS-232 port connected to the modem; the modem connected to the telephone, with the two tones sent out at just the right frequency and level; and properly decoded tones from the other system.

There is not much I can do to help with your software. If your program is so squirrelly that you have to have a checklist to get it to run, you are on your own. Software usually sets the baud rate, so be sure it is thinking 300 in all the right places. Often, programs initiate the UART only on start-up. If you have been fooling around with the system, the UART may have dropped out, so you may need a re-start.

Your RS-232 port should be set for full duplex, even parity, one stop bit. If you have any questions about parity, stop bits or ASCII codes, see Peter Stark's explanation in the November 1978 Kilobaud Klassroom (p. 38).

Loose wires and bad connections are the culprits to watch for between the computer and modem. Are you sure your DB-25 connector has no shorts or cold solder joints? One wisp of wire can short your data into oblivion.

To troubleshoot the modem and phone line, first run an elementary check. Throw the modem into answer and listen to the tone while you hit the return key. You should have no trouble hearing the change as the ASCII character is sent.

If you have a self-test feature on the modem, talk to yourself. What is the environment, both electrical and acoustical, around the modem? Do you have the modem sitting near the computer cooling fan? Do you play rock music while telecommunicating? These noise sources will be picked up by the phone and mask the tones.

The modem signal has to go out over cross-country lines originally designed for analog voice transmission. This is a hostile environment to digital signals. The least you can do is keep the signal-to-noise ratio at its best level at the point of origin.

Watch out for electrical noise, too. I used to keep my phone on top of my monitor. I had a high hum level, but attributed it to other causes. One day when I moved the phone, the hum disappeared. I had introduced noise on the signal that may have caused poor communications under marginal conditions. Keep the telephone away from all power transformers and fan motors.

The telephone companies of the U.S. provide a tremendous amount of

service at a low cost. Their tolerances are high, but strange things can happen.

One common problem on long-haul circuits is frequency translation. The 2225 Hz tone you transmitted may come out 2230 at the other end. This is tolerable, but if one or the other modems is off by 20 Hz, the accumulated error may throw you off. If you have frequent problems of garble and disconnects, use a frequency counter to check your transmitted tones.

Listen to your local phone line. If you have many pops, crackles and dialing pulses, you should discuss the problem with your local telephone company. It is possible that they may be able to find you a cleaner pair for your local service drop.

Finally, listen to the long-distance phone line as you get the first ring. Lines usually become quieter when the other end answers and you are disconnected from the ringing machine, but if you get a noisy circuit, hang up and dial again.

Most cases of intermittent operation can be traced to modem or phone line problems. Be patient and make sure all of the bits and pieces of your system fit together properly.

Spotlight

Most electronic bulletin systems are open forums; few are dedicated to one particular subject. One of the first special-interest systems is the Family Historians Forum run by Paul and Sara Andereck in Fairfax, Virginia.

This bulletin system specializes in genealogy. It serves as a meeting place for persons knowledgeable about the the area or those who are simply interested or curious. The format includes a special area where family names are listed. Persons with any knowledge of the background or history of those names are invited to comment. Professional researchers also advertise their services on the Family Forum.

Paul plans to give the system a capability to accommodate five-level, as well as ASCII, callers. He wants to serve deaf users and to be a model for other systems. Paul informs me that there are about 40,000 five-level communicating terminals used by the deaf in this country. We will watch closely to see how Paul integrates the two transmission systems.

The Family Forum does not use unique software. Paul has simply made cosmetic changes to the Forum-80 software. The program runs on a 48K TRS-80 with four disk drives. (Phone: 703-978-7561.)

This kind of specialized bulletin system is the obvious next step in the development of telecommunications using microcomputer systems. The specialized system suits specific interest groups that are geographically spread and have much detailed information to exchange. It would be well suited to collectors and specialists. I can foresee such special-interest groups as the Videotape Bits, Antiques 80, Old Ford Forum, Firearms Forum and the Bottle Collectors Byte springing up any day now.

Certainly, electronic bulletin systems present a faster method of reaching a small audience than mass publications. Each medium—print, direct mail and electronic—has a specific use. The U.S. telephone system cannot yet support totally electronic information systems. Until they can, we will have a changing and

The following list provides the location, phone number and other information about dial-up computer communications systems around the country. Unless otherwise shown, all systems operate 24 hours a day. Hit a few carriage returns when the system answers the phone to set the speed. Notice the new special interest systems. These are part of an important and valuable trend in the use of microcomputers.

I have personally checked into all of these systems. That is my only guarantee. These were verified from my list of over 120 "reported" numbers.

LOCATION	PHONE NO.	COMMENTS
California		
Anaheim	714-772-8868	ABBS.
Pasadena	213-799-1632	ABBS.
Santa Fe Springs	714-739-0711	ABBS.
District of Columbia		
Washington	703-734-1387	This CBBS can go 110, 300 or 600 baud. Interested in system linking and amateur radio services.
Florida		
Ft. Lauderdale	305-772-4444	Forum-80.
Georgia		
Augusta	404-790-8614	ABBS.
Augusta (South Carolina)	803-279-5392	Forum-80.
Illinois		
Downers Grove	312-964-7768	ABBS, non-business hours.
Kansas		
Kansas City	816-931-3135	Market-80, special purpose for commodity market traders. 6 PM–8 AM. Mon.–Sat.
Olathe	913-782-5115	Avionics-80, special purpose for persons in avionics.
Michigan		
Mt. Clemens	313-465-9531	Medical Forum-80. The second system dedicated to medical technology. Not 24 hr.
Nevada		
Las Vegas	702-873-9491	Forum-80.
New Jersey		
Marlton	609-983-5970	Non-business hours only.
Ohio		
Columbus	614-272-2759	CBBS. General purpose and amateur radio.
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Dallas	214-634-2668	ABBS with a very large disk memory system.
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Vancouver	206-524-0203	ABBS with local club news.

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growing mix of ways to spread the word. Specialized bulletin systems are a welcome addition to the information world.

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Computer mail is the capability to exchange written messages between computers. This computer mail system is called PAN. In Greek mythology, PAN was the illegitimate son of the gods' messenger, Hermes. PAN was inspired by a system called HERMES designed for bigger computers.

The software for PAN is being marketed by the People's Computer Company in Menlo Park CA. It first came out for the PET, but versions for other computers should be ready by the time this is printed. The good news is that the PET software only costs $12. The bad news is that an auto dial/answer modem is needed. The one for the PET made by the NetWorks costs over $300.

A microcomputer under PAN control must have a clock so it knows when to do its thing. At a specified time, the desired number is called. If PAN does not get a modem carrier, it hangs up and tries again later. When it does get a modem tone, it will transmit its message and hang up. While it is waiting, it will receive and record any message from a PAN terminal or any other terminal using the correct control codes. It will also reply to questions if the proper query code is used.

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The Dial-up Directory is soliciting your comments on any aspect of public data communications, equipment, software and systems. Send paper mail to: PO Box 17283, Montgomery AL 36117. Leave electronic mail on the Atlanta Remote Northstar, (404) 939-1520, or send it to TCB967 on the Source. ■

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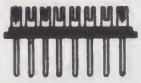


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TIS-16LP	16	N/A	.20	.18	.16	.13	.12
TIS-18LP	18	.30	.25	.22	.18	.15	.13
TIS-20LP	20	.30	.25	.23	.20	.17	.145
TIS-22LP	22	.35	.30	.25	.22	.19	.17
TIS-24LP	24	.40	.35	.30	.24	.20	.18
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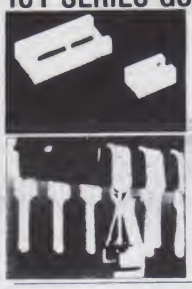


PART NO.	PINS	PRICE 1-9	10-24	25-99	100-249
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KNX-14DP	14	.65	.60	.58	.55
KNX-16DP	16	.70	.65	.62	.58
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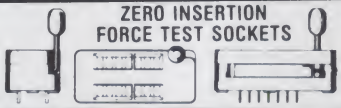


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RNS-18WWG	18	.85	.75	.70	.65	.60
RNS-20WWG	20	1.00	.90	.80	.75	.70
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RNS-24WWG	24	1.25	1.15	1.10	1.05	1.00
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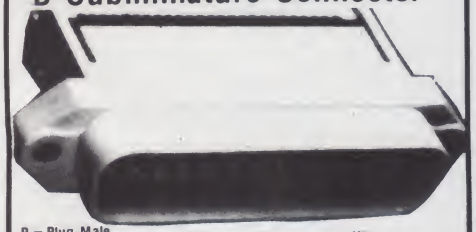
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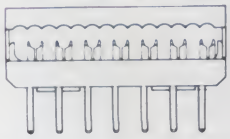
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IDC-DA15P	15	4.20	3.75	3.40
IDC-DA15S	15	4.85	4.35	3.90
IDC-DA15C	15	1.25	1.10	.95
IDC-DB*25P	25	6.00	5.20	4.70
IDC-DB*25S	25	6.35	5.60	5.00
IDC-DB*25C	25	1.50	1.35	1.20
IDC-DC37P	37	8.00	7.20	6.40
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IDC-16DP	16	1.60	1.45	1.30
IDC-24DP	24	2.20	2.00	1.80

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IDC-26CE	13/26	4.75	4.30	3.80
IDC-34CE	17/34	5.70	5.10	4.50
IDC-40CE	20/40	6.50	5.80	5.25
IDC-50CE	25/50	7.00	6.30	5.40

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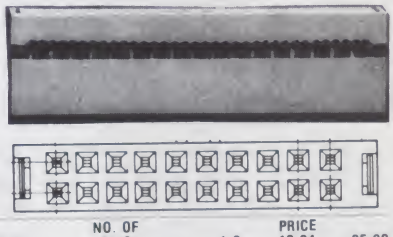
PART NO.	NO. OF CONDUCTORS	PRICE PER SPOOL 10 Ft.	100 Ft.
IDC-09CC	9	N/A	26.20
IDC-14CC	14	4.60	36.65
IDC-16CC	16	5.20	42.00
IDC-25CC	25	N/A	68.15
IDC-26CC	26	8.50	68.15
IDC-34CC	34	11.00	89.10
IDC-40CC	40	N/A	104.85
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IDC-16GY	16	4.00	30.20
IDC-20GY	20	N/A	38.50
IDC-25GY	25	N/A	50.32
IDC-26GY	26	6.00	50.32
IDC-34GY	34	8.10	65.25
IDC-40GY	40	N/A	76.85
IDC-50GY	50	11.00	93.10

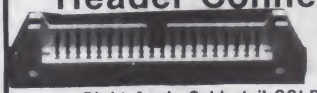
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IDC-34SKT	17/34	4.20	3.75	3.30
IDC-40SKT	20/40	5.00	4.50	3.90
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IDC-RAH 34WWG	5.00	4.75	4.50
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IDC-RAH 50WWG	6.80	6.20	5.50

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An Introduction to Pascal

An in-depth look at this relatively new entrant in the microcomputer language field.

Jim Gagne M.D.
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Pascal has recently made a grand entrance onto the microcomputer scene, with last year's release of an impressive Pascal compiler and development system for 8080 and Z-80 computers by the University of California at San Diego (UCSD) computer science department. UCSD has completed implementations of Pascal for certain 6502-, 6800- and 9900-based systems and also recently announced a system for the Apple II.

Articles have appeared in computing and electronics journals singing the praises of this new microprocessor language, and there have been predictions from a number of quarters that Pascal will eventually replace BASIC as the standard microcomputer high-level language. For instance, the manufacturers of the new 16-bit microprocessor chips being released this year are fully supporting Pascal in their development systems. An even better omen is that the Department of Defense just selected a slightly modified version of Pascal as their official language. (The last such choice, made over a decade ago, was COBOL, which, as a result, has become the most commonly used computing language.)

> **There have been predictions that Pascal will eventually replace BASIC as the standard microcomputer high-level language.**

Pascal was created by Niklaus Wirth in Zurich in 1968 as a proposal for a new high-level computer language intended to correct the faults of the early compilers such as FORTRAN, COBOL, BASIC, etc. The first implementation was completed in 1970, and it has been used increasingly since that time.

The present Pascal project at UCSD began when Kenneth Bowles decided to buck tradition and use Pascal as the preferred language to teach beginning computer programmers. Indeed, it has been shown that students programming in Pascal learn their craft more quickly and are better programmers than those beginning with BASIC or FORTRAN.

Until recently, most programming courses have utilized FORTRAN, BASIC or COBOL, because "that's what everyone uses," despite the many programmers who have lamented the inadequacies of these languages. And, of course, "everyone uses" these languages because that's what they were taught. In this way, student programmers have been locked into a vicious cycle, which is beginning to abate with the growing commitment to Pascal in educational centers.

What is Pascal and why has it created so many converts? As a dedicated Pascal fanatic, I will introduce you to some of its features and then I hope to convince you of its superiority over other languages available for micros at the present time.

Structured Programming

Let us begin with a brief discussion of "structured programming," which forms the core of Pascal and is responsible for much of its power. This term refers to a particular way of approaching programming that many computer experts feel is systematic, logical, easy to understand and the least likely to lead to errors. For further information, refer to the many articles and books on the topic that have appeared recently.

Structured programming was designed to attack a key computing problem: while computer hardware has made gargantuan leaps in computing power, speed and cost reduction in the 30 years since the first vacuum tube machine, the art and science of programming has by no means kept pace. Murphy's Law rules programmers, and everything possible goes wrong. Any but the simplest efforts are

never done on time, never work quite right and become harder to maintain as corrections and additions accumulate. Remember all those insanely stupid computer errors you used to complain about when the computer belonged to the bank?

Structured programming consists of several key concepts: systematic program development, good documentation and clear program flow.

First, you're not likely to wind up with the best program if you start out with a vague idea of what you want your computer to do, sit down at a terminal, start to type out assembly or BASIC code and then run it to see what happens. Programmers appear to have the best chance of success when they work in a systematic way. Thus, programs should be developed as follows:

1. Define precisely what your program is to do. Nail down the content and format of inputs and outputs.

2. Using a flowchart or English descriptors of program flow (see below), write out *in English* the steps your program should follow. The idea here is to divide and conquer. Break up your program into sections in which each performs an individual task and can be individually designed and perfected. For example, imagine trying to design an automobile without clearly distinguishing the engine from the transmission or the differential from the tires. Much of your skill as a programmer lies in your ability to create intelligent, functional subdivisions within your program.

3. Using plain English, further break down your parts into subparts, until each individual section will be easy to write and debug on its own. Notice that, so far, we still have written no code.

4. Now translate the plain English of your program flow into whatever language you are using, section by section, starting with the simplest and most basic parts. Debug and correct each subsection individually before proceeding.

5. Begin to combine pieces of your program into larger and larger functional units, along the lines of the divisions you have established earlier. Because program subsections frequently interact in an unforeseen manner, you must check that each piece works as planned now that it is part of a growing assembly.

6. In this way, bring together the whole program.

It is sometimes difficult for beginners to understand how critical it is for programs to be easy to read and follow. By analogy, imagine wiring up your own circuit of several different parts by tossing together a tangle of components and wires, rather than using a neat wiring technique. Don't bother to make a wiring diagram (remember, you're in a hurry!). Now fiddle with the circuit until it works and stick it in your instrument case. Can you imagine opening the cover on this mess 6 months later when you find there is some problem with the circuit, or you want to add a feature or show a friend what you did?

Programs can be at least as complicated as any circuit, and it's relatively rare that you'll never want to add something, correct a subtle bug that appeared some time after you thought it was working or try to explain to someone else what it does.

Good documentation (adding to your code whatever explanation is necessary to clarify what is happening) will simplify these tasks.

Program Flow

Another major concept of structured programming is careful control of program flow, which is how your program gets from what it is doing now to what it will do next. Naive programmers typically have extremely sloppy program flow, contributing greatly to the poor reliability of their productions. Reliable program flow is generally considered to consist exclusively of combinations of the following structures.

1. Sequential steps, doing one thing after another. For example:
Stand up.
Turn to your right.
Pick up a pencil, etc.

2. Procedures and functions. These are separate portions of the program that perform individual pieces of action. During program operation, control passes temporarily to the procedure or function while it's doing its thing and then returns to the spot in the program that called the routine. In BASIC, these are both known as subroutines. The difference between a procedure and a function is that a procedure performs a process without returning a result to the calling routine (e.g., clear the CRT screen), while functions process data and return some result (e.g., calculate the sine of x).

3. The IF-THEN structure. IF some condition is true, THEN do something and go on with the program. Otherwise, just go on with the program:
IF you love ice cream,
THEN let's go get some.
Next statement, etc.

4. The "IF-THEN-ELSE" structure. IF some condition is true, THEN do action number one and go on with the program, or ELSE do action number two and go on with the program:
IF you eat ten pounds of candy a week,
THEN you'd better go to the dentist every month,
ELSE twice a year is plenty.
Next statement, etc.

5. The CASE structure, a special instance of the IF-THEN-ELSE structure. Here, there are multiple possibilities—not just two—each with its own individual action. The best known example is the child's alphabet:
In CASE the letter is:
A, write "apple";
B, write "bug";
C, write "cat";
. . .
. . .
Z, write "zebra"
END [of case structure]
Next statement, etc.

6. The DO-WHILE structure. WHILE some condition is true, DO something, then go on to the next step. Skip the something if the condition is not true to begin with:
WHILE you have more money than you know what to do with,
DO give some of it to me, etc.

7. The REPEAT-UNTIL structure. REPEAT one or more steps UNTIL some condition is met. Notice that here the action is performed at least once:
REPEAT paying taxes every year
UNTIL you are six feet under.

8. The Loop structure, also known as a DO loop. This is for repeating one or more steps a set number of times:
FOR 100 times,
DO write on your terminal, "I will pay more attention to my wife."

Pascal is the first microprocessor language that allows you to program for serious applications such as running the bookkeeping for a business without making your customer wait forever for the program to run or load data.

Pascal Programs

Now let's look at Pascal itself. You may be pleased to know that you have already learned something about it, since Pascal's control structures are virtual duplicates of the eight program flow structures noted above.

Pascal programs look dif-

ferently on paper from BASIC programs for several reasons. First, with occasional exceptions, there are no forward references. A forward reference is a statement in a program that refers to a subroutine or a variable that won't be defined until later in the program. Therefore, you are required to define any variable, constant or procedure names before you use them.

Also, there is enormous flexibility in the types of data that may be referenced by constant and variable names (unlike BASIC, for instance, which must have "$" following the name of a string variable). So you can create a variable named "MONTH," which has as its possibilities the twelve months of the year, or "DAYOFTHEWEEK" (long variable names are just fine), which consists of SUNDAY, MONDAY, . . .,SATURDAY, or COLOR (RED, GREEN, etc.). Imagine trying to keep track of colors in BASIC. ("Let's see, I'll make up an array of C(1) through C(11) and someplace I'll keep a list of what each number means.")

```
PROGRAM CHOP (INPUT, OUTPUT);
VAR SUBJ: STRING;
    POSSPACE: INTEGER;

PROCEDURE CHOPAWORD;
BEGIN
  WRITELN (SUBJ);
  POSSPACE := POS (' ',SUBJ);
  DELETE (SUBJ,1,POSSPACE),
END (*CHOPAWORD*);

BEGIN  (*MAIN PROGRAM*)
  SUBJ := 'I AM GOING TO ALL THIS TROUBLE TO ERASE WORDS?';
  REPEAT CHOPAWORD UNTIL POSSPACE = 0.
END.
```

Example 1. Sample Pascal program that chops off words from a sentence. Adapted from (Microcomputer) Problem Solving Using PASCAL *(see reference 2).*

This flexibility is another reason that you must define each constant and variable, generally right at the beginning of the program, before you use it. Anything unusual in the program (forward references, for example, or a reference to data or procedures outside the program) must also be declared right away.

Here is the general way a Pascal program is structured:

Program title and declaration of files used;
Declaration of constants;
Declaration of special variable types;
Declaration of the variables themselves;
Declaration of any weirdness;
Procedure ABC heading;
  Declaration of any local constants or variables;
  Procedure body;
Procedure XYZ heading;
  Declarations and body as above;
Function ABRACADABRA heading;
  Declarations and function body similar to above;
Main program body;
End of program.

Let's explain two features in the above example I had not mentioned before. First, a "local" constant or variable is one that is used only in a limited area of the program. If you're careful, this will give you the ability to use the same local variable or constant name (for example, a loop counter, integer "I") in two different procedures without interference with each other, provided they are in unrelated parts of the program. Furthermore, you won't clutter up the main program body with a lot of loop counters and other paraphernalia used only in one area.

There is a lot of fine print concerning local variables in the definition of Pascal, and it is probably best for beginners to define all constants and variables at the start of the program, where they are available to the whole program, using different names as needed.

Second, notice the semicolons at the end of each line. While the above structure is in no way a real Pascal program, I included the semicolons for purposes of introduction. It is important to remember that Pascal ignores carriage return/line feeds and spaces, except to mark the end of a datum or an identifying word. This allows you great freedom in structuring the format of your program so that it makes the most sense to



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```
I AM GOING TO ALL THIS TROUBLE TO ERASE WORDS?
AM GOING TO ALL THIS TROUBLE TO ERASE WORDS?
GOING TO ALL THIS TROUBLE TO ERASE WORDS?
TO ALL THIS TROUBLE TO ERASE WORDS?
ALL THIS TROUBLE TO ERASE WORDS?
THIS TROUBLE TO ERASE WORDS?
TROUBLE TO ERASE WORDS?
TO ERASE WORDS?
ERASE WORDS?
WORDS?
```

Example 2. Output of Chop program.

the reader. Thus, you must tell the compiler when a statement has ended, and semicolons have been chosen for this particular function.

Pascal is very picky about its semicolons, absolutely requiring them in certain areas and griping if you include them in the wrong spots. Usually beginners find them to be a nuisance, becoming confused at first about when they must put them in and when not to. Often, you'll simply forget to include them, and the compiler will stop and give you an error message. Still, semicolons beat the line numbers required by BASIC any day. It took me about a week to get it straight.

Finally, notice that the main program body is at the end. Thus, when you're reading a Pascal program, it's usually best to start at the end, where you can get a sense of the overall program. Then you work your way to the beginning, where the simplest subroutines are. Seem backward?

Actually, as I mentioned above, the Pascal format follows the way you should be actually writing programs—simplest parts first. This will be hard to do unless you sit down and write out your program structure ahead of time—with pencil and paper—as you're supposed to do anyway. So you can see how Pascal will assist you in writing programs properly.

Program Structure

Now let's look at the structure of an actual Pascal program, listed in Example 1. Its output is in Example 2. For simplicity, I have chosen a program that uses features unique to UCSD Pascal, not present in the original Jensen and Wirth definition (see reference 1) of the language, but easily added if you don't have the UCSD version. Note that there are no constants, and the only variables are SUBJ, of type STRING (a type added by UCSD Pascal), and POSSPACE, of type INTEGER. There are no local variables. Next, notice the two BEGIN . . . END pairs. These act as markers for the start and finish boundaries of a group of statements.

One of the great advantages of Pascal is that it is "block structured," meaning you can put a whole block of statements anywhere a single statement would normally go by starting off the block with BEGIN and finishing it with END. In practice, the BEGIN . . . END pairs are used primarily to demarcate boundaries of procedures, functions and the main program and also to insert blocks of statements within program flow structures, as we will see in the Pascal program we will write.

Notice the funny-looking equals signs declaring the values of variables POSSPACE and SUBJ, following the variable-type declarations. This symbol, ":=", is called the "assignment operator," which means, "put the quantity listed on the right-hand side of the

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symbol into the address denoted by the name on the left-hand side of the symbol." So it's really the same as the LET X = 1 statement in BASIC. (In contrast, the = sign really means "equals," as in . . . UNTIL POSSPACE = 0 later on in program.)

Finally, notice the "(*" and "*)" symbols. These denote comments, or explanatory text, which is ignored entirely by the compiler. Comments are not part of the program proper, but they certainly assist you in remembering what's going on.

Now let's look at the program itself. Lines 2 and 3 (beginning with VAR) are the variable-type declarations. PROCEDURE CHOPAWORD is next and begins by writing out as one line ("WRITELN") whatever string variable SUBJ contains at the moment. The next line (POSSPACE := POS (' ', SUBJ)) instructs the program to put the number of the POSition of the first character in string SUBJ (that is, a space) into POSSPACE. If no space is found, then POSSPACE will be set to zero.

The next line says to DELETE within string SUBJ all the characters from position 1 (the second parameter within the parentheses) through position POSSPACE (the third parameter), thus deleting exactly one word. However, if no space is present, POSSPACE has been set to zero, and nothing is deleted. So, for example, at the start of the program, the first space in SUBJ is the blank at position 2, following the character I. Deleting the first two characters deletes one word.

Once you've gotten this far, the rest is easy. The main procedure defines SUBJ and then repeatedly calls CHOPAWORD until the sentence is down to one word and POSSPACE = 0. Note that the program isn't cluttered by CALL or GOSUB; instead, the procedure is just named. The end of the program is denoted by the period after the last END.

Now, using the structured programming technique I discussed earlier, let's write a Pascal program to invent a short math quiz.

Writing a Pascal Program

In general, what do we want to do? Let's have the program ask for two numbers, decide on the arithmetic operation to be performed, then tell the user what the operation is and ask for the result. We'll make it pester the user until he gets it right. The user will then have the option to quit the program.

Let's begin to divide the program into functional subsections. The program should begin by initializing (typing out instructions and setting the initial values of variables) and then running the quiz until it's time to quit.

1. WRITE INSTRUCTION SECTION AND INITIALIZE VARIABLES.
2. KEEP REPEATING THE QUIZ UNTIL THE USER WANTS TO QUIT.

That was easy. The inputs and outputs will consist of numbers entered one at a time, so it's not necessary to set up an input/output format. So we're ready to expand on our form.

1. WRITE INSTRUCTION SECTION AND INITIALIZE VARIABLES.
2. KEEP REPEATING THE QUIZ UNTIL THE USER WANTS TO QUIT.
   A. Request and obtain first and second numbers.
   B. If both are zero, then quit (an added feature). Else (otherwise) do quiz.

Now consider the next level of expansion.

1. WRITE INSTRUCTION SECTION AND INITIALIZE VARIABLES.
2. KEEP REPEATING THE QUIZ UNTIL THE USER WANTS TO QUIT.
   A. Request and obtain the first and second numbers.
   B. If both are zero, then quit. Else do quiz:
      i. Decide arbitrarily if math operation is to be addition, subtraction or multiplication and calculate the result.
      ii. Inform the user of the type of operation and obtain a guess. Let him know if he got it. Keep repeating this step until he gets it right.
      iii. Find out if the user wants to quit.

Let's do one more level of expansion before writing the program.

1. WRITE INSTRUCTION SECTION AND INITIALIZE VARIABLES.
2. KEEP REPEATING THE QUIZ UNTIL THE USER WANTS TO QUIT.
   A. Request and obtain the first and second numbers.
   B. If both are zero, then quit. Else do quiz.
      i. Decide arbitrarily if the math operation is to be addition, subtraction or multiplication and calculate the result.
         a. If second number > three times the first number, then the operation is multiplication. Else:
         b. If the second number > the first number, then the operation is subtraction. Else it's addition.
      ii. Inform the user as to the type of the operation and obtain a guess. Let him know if he got it. Keep repeating this section until he gets it right.
      iii. Find out if the user wants to quit.

This program is so short and simple that I was able to write it in one shot, though if we wished to be purists, we could divide everything into separate procedures. Look at the finished code in Example 3. You should have no trouble figuring out what each line does if you compare the format structures discussed earlier with the detailed, plain English description we just completed.

Note that we use the two forms of writing to the console (WRITE and WRITELN) and reading from the console keyboard (READ and READLN). The difference is simple: *WRITE* ('xyz') just prints "xyz" (or whatever is listed in the parentheses), whereas WRITELN does a WRITE then goes to the next line. "WRITELN" without anything in parentheses simply skips to the next line. Similarly, READ reads a number or character, whereas READLN waits for a carriage return/line feed before acting on the information, much like BASIC. If you run the program, you'll find that it will wait for you to type an end-of-

Example 3. Math quiz.

```
PROGRAM MATHQUIZ (INPUT, OUTPUT); (* program title *);
(* next are variable declarations, all standard UCSD types *)
VAR     firstno, secondno, result, guess: INTEGER;
        operation: STRING;
        quit: BOOLEAN;
        keepon: CHAR;

BEGIN (* MAIN PROGRAM *)
  WRITELN ('This program will test your math acuity.');
  WRITELN ('Type in two numbers from 0 to 100.  MATHCHEK will');
  WRITELN ('then ask you for their sum, difference, or product.');
  WRITELN ('If you are correct you will be rewarded, and you');
```

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```
  WRITELN ('KNOW what happens if you are wrong...');
  WRITELN ('you get to try again and again until you get it right!');
  quit := FALSE;

REPEAT (* MAIN PROGRAM LOOP *)
  WRITELN;  (* provide a blank line *)
  WRITE ('What is the first number you wish to try?  ');
  READLN (firstno);
  WRITE ('Now the second number?  ');
  READLN (secondno);
  IF (firstno = 0) AND (secondno = 0)
    THEN quit:= TRUE
    ELSE BEGIN
      IF secondno > firstno * 3
        THEN BEGIN
          result := firstno * secondno;
            operation := ' multiplied by '
          END (* then *)
          ELSE IF firstno < secondno
            THEN BEGIN
              result := secondno - firstno;
              operation := ' subtracted from '
            END (* then *)
            ELSE BEGIN
              result := firstno + secondno;
              operation := ' added to '
            END (* else *);
    (* NOW RESULT AND OPERATION HAVE BEEN FIGURED OUT.  *)

        REPEAT
          WRITE ('What is ', FIRSTNO, OPERATION, SECONDNO, '?');
          READLN (guess);
              IF guess = result
                THEN WRITE ('YOU GOT IT!  ')
                ELSE WRITELN ('Sorry, you blew it.  Try another answer.')
        UNTIL guess = result;
        WRITE ('Want to try again?');
        READ (keepon);  (* one character only *)
        WRITELN;     (* terminate line automatically *)
        IF (keepon <> 'Y') AND (keepon <> 'y') THEN quit := TRUE
      END (* else *)
  UNTIL quit
END (* PROGRAM *).
```

line when entering the numbers (READLN), but will respond instantly when you tell it whether you want it to continue (READ).

Advantages of Pascal

So far, we've used fairly simple programs that could be easily duplicated with BASIC, though the programs would be longer and not nearly so clear. So what's so special about Pascal?

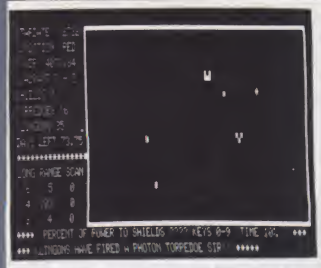
First, Pascal is truly machine independent, at least in the UCSD version. The output of the compiler is in the form of a hypothetical machine language called P-machine code. Though until recently, there was no actual physical P machine, it is not terribly difficult to emulate or imitate this P machine on other microprocessors via a program called a P-machine interpreter. Thus, if you write and compile a Pascal program on your PDP-11 minicomputer, your P-machine code will run unaltered on my Z-80 or 8080 machine, so long as we both have P-machine interpreters for our respective host machines. Even the disks are the same!

In addition, P-machine code is much more compact than BASIC source code or even machine code, so your files consume less disk and memory space. Not only that, but it is simple to write a P-code interpreter for a new type of microprocessor, requiring an experienced assembly-language programmer less than a month's time to write, including the input/output sections.

So UCSD was able to write their entire operating system directly in Pascal and have it work on every machine. This allowed them to pay a lot of attention to the operating system, and, in my opinion, it is the best available for micros.

Moreover, the disk operating system is vastly superior to that of any other microprocessor. It automatically puts into memory whatever pieces of program you need, and data files are accessed very quickly. So, in my opinion, Pascal is the first microprocessor language that allows you to program for serious applications such as

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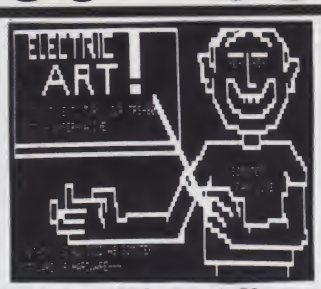
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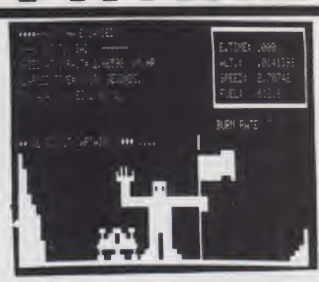
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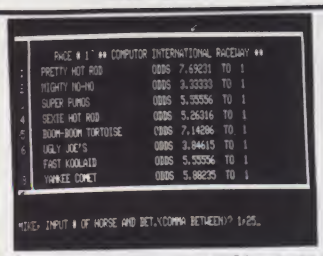
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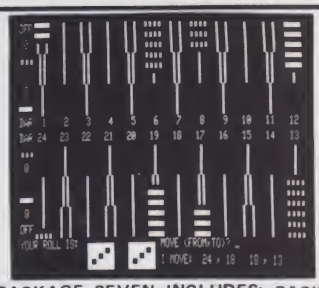
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running the bookkeeping for a business without making your customer wait forever for the program to run or load data.

Second, Pascal runs three times as fast as the very best BASIC, and ten to 30 times faster than most. It is somewhat slower than assembly language, and there is a speed penalty if you compare a P-machine approach with a good compiler producing machine language directly. These figures should improve in the next generation of micros.

Third, P-machine code runs optimally on 16-bit machines such as the new generation of microprocessors scheduled for the market. So your programs are likely to run unaltered on the next generation of hardware, even faster than they do now. In fact, Western Digital has announced the hardware implementation of the P machine on a three-chip set of integrated circuits, which runs Pascal five to ten times faster than any other available mini or micro.

Fourth, Pascal offers the best data structures of any general programming language. Data structures are just that: the way you structure or represent the data your program is working with. For instance, it is troublesome to represent all the needed data for an employee or industrial account file in BASIC, let alone getting at it easily. By contrast, Pascal helps you out, so it's effortless. For example, to set up a RECORD (a group of related but different data) for an employee file, you would enter the following data near the beginning of the program:

```
EMPLOYEE:
RECORD
NAME: STRING (20); (*'(20)' MEANS A
LIMIT OF 20 CHARACTERS *)
STREETADDRESS: STRING (30);
CITY: STRING (20);
STATE: STRING (2);
ZIP: STRING (5); (*OR YOU COULD USE AN
INTEGER, PROVIDED THE MAXIMUM IN-
TEGER VALUE WAS AT LEAST 100,000. IN
THE PRESENT UCSD SYSTEM, YOU'D
NEED DOUBLE PRECISION.*)
SEX: (FEMALE, MALE);(*YES, THE VALUE
OF THIS VARIABLE IS ONE OF TWO
WORDS, MALE OR FEMALE.*)
EMPLYEENO: INTEGER (10000. .30000); (*
THIS FORM ALLOWS BUILT-IN RANGE
CHECKING TO CUT DOWN ON CATA-
STROPHIC TYPOS. THE ONLY ALLOWED
VALUES ARE 10,000 TO 30,000. *)
SOCSECURITYNO: STRING (10);
HOURLYWAGE: INTEGER;
IRSWITHHELD: INTEGER;
FDICWITHHELD: INTEGER;
STATETAX: INTEGER;
CITYTAX: INTEGER
(*MISCELLANEOUS DEDUCTIONS *)
HEALTHINS: INTEGER;
CREDITUNION: INTEGER;
UNITEDFUND: INTEGER;
END;
```

Then, when you wanted to refer to the social security number within a given record, you'd say EMPLOYEE. SOCSECURITYNO. Simple, is it not?

One of the nicest things about Pascal is the vigorous standardizing activity that is continuing to occur. Unlike PL-1, which is so overburdened with features that it is difficult to use, an explicit goal of Pascal is to keep the language simple enough that it is practical for machines of various sizes yet contains all the elements a serious programmer is likely to require.

As with any other language, each group of programmers that implements the compiler for a given machine includes its own extensions to the standard that it considers essential for its own use, creating a problem of program compatibility. To insist on retaining the original Jensen and Wirth standard as experience with Pascal grows is silly; the problem is getting any group of implementors to agree on essential extensions yet still keep the compiler manageable. The IEEE standards committee on Pascal seems to be making remarkable headway in this direction, and, unlike BASIC, we can expect that Pascal source code will be highly portable among various implementations on various machines.

In addition to all the above, there are a number of miscellaneous improvements over BASIC. First, as shown earlier, you have the option of not requiring a carriage return when a letter is typed, speeding data entry. Second, there is now a library capability, allowing your programs direct access to a collection of commonly used routines stored on the disk, either during compilation or at run time.

Finally, as you can see, once you've learned the language, Pascal programs are so much clearer than those of most other languages that they are easy to follow, so your mistakes are easier to find and changes simpler to implement. Everything is already in a form of English that you can understand, which is why Pascal is said to be "self documenting." (But don't take this too literally—you still need comments to explain what you're doing.)■

A New, Minimal-Cost Software Club for Users of UCSD Pascal

Once the UCSD Pascal* P-code interpreter is installed, programs written in UCSD Pascal can be run on any microprocessor without modification. Even the disk formats are the same, except for the mini-floppies used for the Apple, North Star or TRS-80. Disk software in either source or object form may be freely shared among users of such diverse machines as a PDP-11 or an 8080.

The Pascal Users' Group

To date, only the original Pascal Users' Group ("PUG") has arisen to share software. Only secondarily does PUG disseminate software (based on Jensen and Wirth Pascal), although since 1978 PUG has published several superb "software tools." The PUG newsletter is available only on paper; any machine-readable software is offered on 9-track tapes, which are not supported by the majority of microcomputers. So you have to type the software into the machine on your own.

UCSD Pascal Users' Group on Machine-Readable Media

Datamed Research is announcing the formation of a UCSD Pascal Users' Group in a form similar to the respected CP/M Users' Group: all offerings on 8-inch, single density, IBM-compatible soft-sectored floppies, offered virtually at cost ($10 per disk); software donated by interested users. Software donors receive a free disk volume of their choice in acknowl-

Annotated Bibliography

1. Jensen, Kathleen, and Wirth, Niklaus. *PASCAL User Manual and Report*. New York: Springer-Verlag, 1975.
This is the current Pascal bible, the standard from which all others extend their implementations just a little. I have found it useful only as a reference.
2. Bowles, Kenneth L. *(Microcomputer) Problem Solving Using PASCAL*. New York: Springer-Verlag, 1977.
This book, written by UCSD Pascal's daddy, does a fair job of presenting Pascal to the novice user. In addition, it describes several of the extensions UCSD has made to the language, although the graphics package on which many of the book's programming examples rely requires a Terak monitor. I have several complaints: the text is wordy and not always clear (though I could always figure it out). Disk access and other important topics are beyond the scope of the book. The book was originally designed as an adjunct to a university course and is somewhat shaky as a self-teaching text; for example, there are no answers to the exercises. Yet, for what it covered, it was thorough and complete.
3. Grogono, Peter. *Programming in PASCAL*. Menlo Park CA: Addison Wesley, 1978.
This is unquestionably the best Pascal text if you are already experienced in another language. It covers both beginning and advanced features, such as how to treat the same data as different variable types at will.
4. Kieburtz, Richard B. *Structured Programming and Problem Solving with Pascal*. New Jersey: Prentice-Hall, 1978.
This book looks like a great beginner's text, clearer than the Bowles.
5. *Computer Magazine*, Volume 12, Number 4 (April 1979). IEEE Computer Society, 5855 Naples Plaza, Suite 301, Long Beach CA 90803.
Two articles in this issue present a superb overview of Pascal—one detailing the proposed IEEE standard.
6. *Electronics Magazine*. New York: McGraw-Hill.

edgement of their donation. To be accepted for distribution, software *must* come with adequate documentation on the disk. With rare exceptions, it must be supplied in source code to allow other users to adapt it to their systems.

Potential sources of Pascal software abound; by no means must you donate only original work. There is a mountain of public-domain BASIC software that is easily adapted to Pascal. In the process, you can usually spruce up the programs because Pascal is so much easier to work with than BASIC. Users should begin a library of Pascal procedures and functions to handle the more common programming problems.

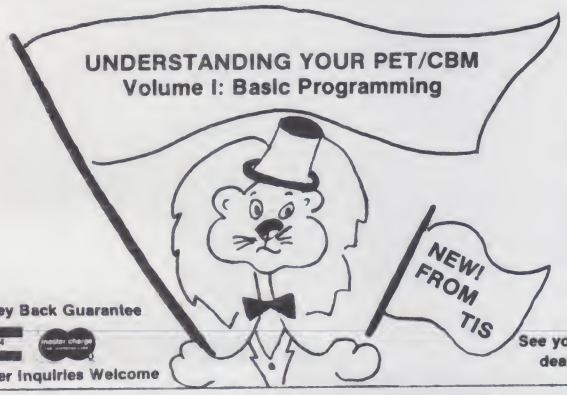
All volumes will also be available on CP/M disks for those using CP/M-compatible Pascal. However, you will be on your own to fit the programs into your memory (remember that native code versions are three times larger) and adapt them to your system. We will be happy, though, to accept Pascal software on CP/M disks if it can be readily adapted to the UCSD system.

As of January 1, 1980, there is enough software and other goodies for the first two volumes; contact Datamed Research directly for the exact number of volumes and their contents. All documentation will be the disks.

For health-care professionals, Datamed has started SOFTDOC, a Pascal-oriented users' group.

For further information, send a self-addressed, stamped envelope to Datamed Research, 1433 Roscomare Rd., Los Angeles CA 90024.

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✓Reader Service—see page 257

Product Evaluation: The APT-1

West Side Electronics' peripheral board, the APT-1, is also known as the Appletime.

Jeffrey G. Mazur
8041 Sadring Ave.
Canoga Park CA 91304

West Side Electronics, PO Box 636, Chatsworth CA 91311, has recently introduced a real-time clock for the Apple II. The Model APT-1, also known as the Appletime, is a single peripheral board that plugs into any slot of the computer. Also included is a small wall transformer that maintains power to the clock board when the computer is turned off. A nine-volt battery can also be connected to take over in case of power failure. Timebase accuracy is maintained with an on-board crystal oscillator or, optionally, via the ac power line.

Since the Appletime comes completely assembled, it is ready to use by simply inserting it into the computer, plugging in the external wall transformer and adding a battery if desired. A short demonstration program, which puts the time on the screen with a border around it, is supplied. Three time-setting switches can then be used to set the correct time.

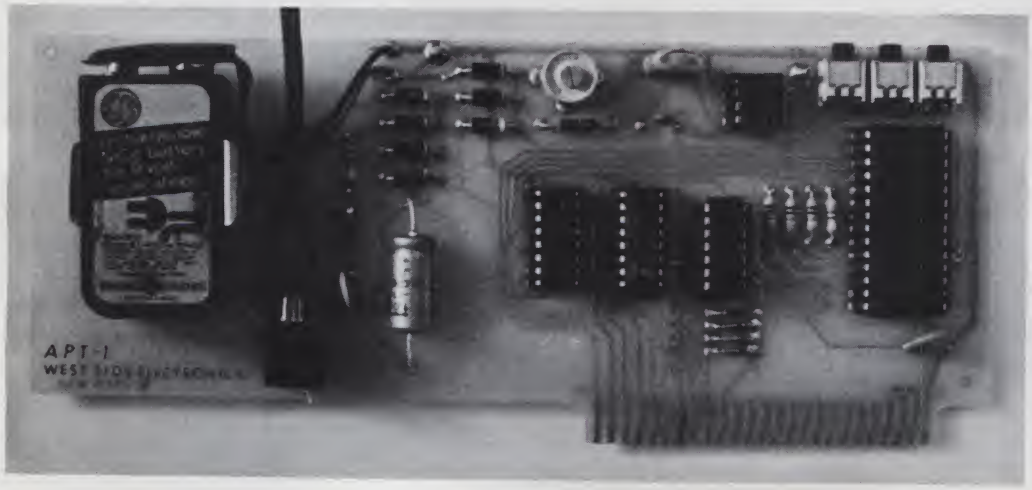
As supplied, the unit is set for 24-hour time, BCD data format, crystal timebase and 60 Hz. Twelve-hour, ASCII format, power line timebase and 50 Hz operation are all possible with simple modifications. Crystal timebase accuracy is better than one minute per year and is adjustable.

The heart of the Appletime is an MM5318 BCD clock chip that performs all of the timekeeping functions. Access to the time information must be made one digit at a time; therefore, the Appletime maps the six digits into a block of the computer's memory. The location of this block will depend upon which slot the card is plugged into, and a complete chart is given that shows all addresses in hex and decimal.

Lines 10-40 in Listing 1 demonstrate how to simply PEEK at the time. However, each line contains two PEEK statements because the MM5318 is relatively slow in responding to address changes (2 us in comparison to 0.5 us for the computer to read it). Thus, the result of the first PEEK is disregarded, and by the time the second PEEK is executed, the data is correct and the proper information is read from the clock.

An alternative to the "double PEEK" method is shown in Listing 2, which uses "anticipated addressing." With the exception of the first line (needed to initialize), each access to a clock digit is made by PEEKing at the address of the next digit to be read. The result of this PEEK will be the value of the last digit accessed.

For example, in line 20 PEEK(-16223) accesses the MU (minutes units) digit. But when the computer reads the data from the clock, it is still putting out the MT (minutes tens) data that was accessed in line 15 by PEEK(-16219). Thus, in line 20 the correct data is as-



The Appletime real-time clock.

```
 1 CALL -936
10 HT= PEEK (-16217):HT= PEEK (-16217)
15 HU= PEEK (-16218):HU= PEEK (-16218)
20 MT= PEEK (-16219):MT= PEEK (-16219)
30 MU= PEEK (-16223):MU= PEEK (-16223)
35 ST= PEEK (-16222):ST= PEEK (-16222)
40 SU= PEEK (-16221):SU= PEEK (-16221)
90 VTAB 12: TAB 16
100 PRINT HT;HU;":";MT;MU;":";ST;SU
110 GOTO 10
```

Listing 1. Double PEEK method of reading the clock. Note all addresses are for Appletime in slot 2.

```
 1 CALL -936
10 HT= PEEK (-16217):HT= PEEK (-16218)
15 HU= PEEK (-16219)
20 MT= PEEK (-16223)
30 MU= PEEK (-16222)
35 ST= PEEK (-16221)
40 SU= PEEK (-16217)
90 VTAB 12: TAB 16
100 PRINT HT;HU;":";MT;MU;":";ST;SU
110 GOTO 10
```

Listing 2. Using "anticipated addressing" to read the clock. All addresses are for Appletime in slot 2.

```
  1 DIM TIME$(8)
 10 GOTO 500
100 X= PEEK (BASE+7): POKE 2056, PEEK (BASE+6)+176
110 POKE 2057, PEEK (BASE+5)+176
120 POKE 2059, PEEK (BASE+1)+176
130 POKE 2060, PEEK (BASE+2)+176
140 POKE 2062, PEEK (BASE+3)+176
150 POKE 2063, PEEK (BASE+7)+176
190 RETURN
500 CALL -936
510 INPUT "SLOT NUMBER ",S
520 BASE=-16256+16*S
530 POKE 2058,186: POKE 2061,186: POKE 2064,0
540 CALL -936
550 GOSUB 800
600 GOSUB 100
610 VTAB 12: TAB 16: PRINT TIME$
620 GOTO 600
800 VTAB 10: TAB 14: PRINT "**********"
810 VTAB 11: TAB 14: PRINT "*        *"
820 VTAB 12: TAB 14: PRINT "*        *"
830 VTAB 13: TAB 14: PRINT "*        *"
840 VTAB 14: TAB 14: PRINT "**********"
850 RETURN
```

Line 1	Initializes a string variable TIME$ as the first variable.
Lines 100-190	Subroutine to read the clock and place time in variable TIME$.
Lines 510-520	Input to calculate base address dependent upon Appletime slot.
Line 530	Places colons between hours, minutes and seconds digits.
Lines 600-620	Main program to read and display time on screen.

Listing 3.

signed to the variable MT and the clock is set up to give the correct data for the MU digit for line 30.

Listing 3 demonstrates how the computer can determine the slot-dependent addresses, and a short subroutine can be used to read the clock and return the present time in a variable TIME$. This variable can then be manipulated and compared to other times.

Unlike other real-time clocks, the Appletime supplies only time-of-day information. No calendar or interrupt facilities are provided. However, its low cost makes it ideal for most applications, which require time only. Teamed with the incredible intelligence of the computer, the Appletime can open up new and practical uses for your personal computer. The Appletime Model APT-1 is available for $79.95. ■

✓Reader Service—see page 257

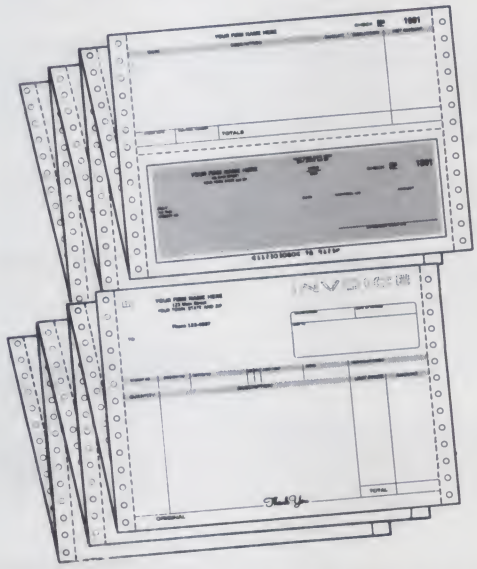
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By Sherwin Steffin and Steven Pederson

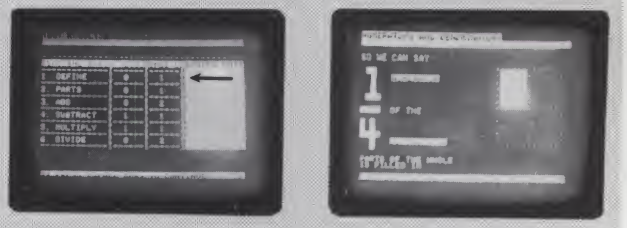
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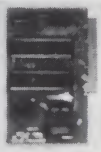
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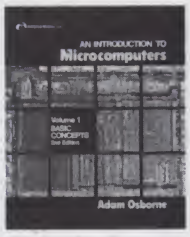
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Questions and Answers On Programming Languages

Sometimes we forget you newcomers. This series will answer some of your questions.

David Price
3901 Victoria Lane
Midlothian VA 23113

Computer veterans are sometimes forgetful. They occasionally forget that the newcomer to microcomputers does not share their detailed knowledge of computer theory. Even the most basic concepts, if left unexplained, are sometimes difficult to comprehend through simple osmosis. That is why I have chosen the familiar question-and-answer format.

Before we begin, let's examine a question that may seem unrelated to programming languages. Why are we starting with this particular topic? Mainly because many *Kilobaud Microcomputing* readers migrated to this hobby from a background in electronics (e.g., amateur radio) rather than software. Concepts relating to software, then, rather than some nuance of computer hardware, are more likely to represent virgin territory. But to keep things from getting scary, we'll open with a nice puffball.

Q: Why does my computer need a special language? Why can't it understand my language?

A: Ordinary English is full of ambiguities. It is too complex to be processed by today's computers. As a substitute, we use programming languages.

Q: What is a programming language, exactly?

A: A good programming language facilitates the production of computer programs. It permits the programmer to express sequences of instructions for a computer to execute. Many programming languages use common English verbs: this often makes the finished program easier to understand.

Q: How many programming languages are there?

A: Dozens.

Q: Then why have I heard of only three or four?

A: Because only a small fraction of existing languages are particularly widespread. In fact, most programming work is now done with one of three major languages: BASIC, COBOL and FORTRAN. Other popular languages include APL, Pascal, FOCAL and SNOBOL.

Q: Which is the best language?

A: Different programmers prefer different languages. No language is "best" for all applications. In choosing a language for a specific application, you must consider many different factors. Assuming that there is, in fact, a choice (many computers support only one language), the "best" language will be the one that is easiest to work with.

Some languages are intended as general-purpose languages, that is, they can handle many different types of applications —but perhaps not as well as a specialized language. BASIC has become popular, in part owing to its generalized nature.

Some languages, conversely, are specialized, that is, they were designed with a narrow range of applications in mind and hence are only marginally adaptable for applications beyond this range. COBOL, for example, is useful when the application involves storage, retrieval and manipulation of large data files. Not surprisingly, it has found wide acceptance among corporate computer operations. Another specialized language, SNOBOL, is adept with complex manipulations of alphabetic characters and texts.

Q: What about the other languages, such as FORTRAN and APL?

A: As you can see, these language descriptions are very simplified, but let's look at a few more of them anyway. FORTRAN, which stands for FORmula TRANslator, was the first programming language. It is still used with engineering and scientific applications. There are several dialects of FORTRAN, the most prominent being FORTRAN IV.

APL is an abbreviation for A Programming Language. It is unique among the major languages in that it does not use words like *print* or *read* to specify operations. Peculiar-looking symbols such as ⌈ and ↑ are used instead. The strength of APL lies in its ability to manipulate sets of numbers called arrays using concise mathematical expressions.

Pascal, a language gaining popularity, is especially favored by proponents of "structured" programming. Pascal programs are normally more concise than programs written in other languages. The programmer writing in Pascal tends not to become as enmeshed in minor details that complicate program design.

Q: It seems as though every microcomputer on the market has BASIC. What is the advantage of the BASIC language?

A: The biggest advantage of BASIC is that it happened to be here first. It was originally developed at Dartmouth for use on their computer. At the time, other languages forced the user to submit himself and his program to certain tedious procedures before the computer would execute his program. BASIC was one of the first "hassle-free" languages and hence became very successful.

Minicomputers manufactured by Hewlett-Packard, DEC, Data General and several other firms employed BASIC. The success of these minicomputers, in turn, made BASIC even more strongly entrenched.

In 1975, the first significant hobbyist microcomputer was introduced by a company called Mits. That computer—and many later rivals from other companies—supported only one language: BASIC. The inertia behind BASIC continues today.

So much for historical perspective. BASIC has advocates and detractors; both sides have legitimate points to make. On the plus side, BASIC is easy to learn. It has been taught to thousands of students in junior high through college. Given a good self-teaching BASIC text, most people can acquire a solid grasp of the language in one afternoon.

On the minus side, BASIC can be unwieldy. As a BASIC program becomes larger, it becomes more difficult to understand. Almost every BASIC programmer has had the experience of discovering a long-lost program, only to find

Fig. 1. Compilers versus interpreters.

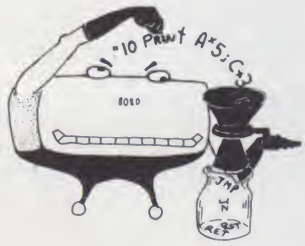


Fig. 1a. A compiler grinds up the source program into an object program that can be used later.

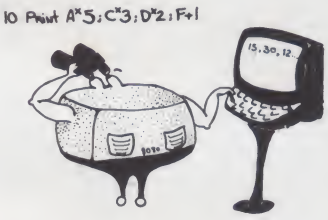


Fig. 1b. An interpreter scans the source program and executes it right away.

that he cannot make the slightest sense of it. There are ways to minimize this effect, but the legibility gap between BASIC and, say, PASCAL can never be eliminated entirely.

Q: Another problem I've heard about is that you can't always take a BASIC program from one system and use it on a different system. Why not?

A: People like to innovate. When a computer manufacturer decides to create a BASIC for his systems, he often includes enhancements or extensions in his version. Sometimes he changes a few elements of the language to make it simpler or more useful.

Since this process has been going on for nearly 15 years, the versions of BASIC used today are radically different from the original Dartmouth BASIC. Not only that, but the various current versions resemble each other even less.

Q: Is "assembly language" another programming language?

A: Yes and no. Assembly language is composed of the instructions recognized directly by the central processor. A program written in the assembly language of one computer would not execute on another type of computer. This is because assembly language is dependent on the design of the processor.

If you've ever seen a listing of an assembly-language program, you probably noticed that it consisted of several columns of apparently meaningless numbers and words. Well, the words are called *mnemonics*, and are the equivalent of verbs like "print" and "read" in other programming languages. The mnemonic JZ, for example, might mean "Jump if Zero."

After an assembly-language program is completed, it is processed by another program called an assembler. The assembler translates the abbreviations (such as "JZ") into their numerical representations. Each mnemonic has its own numeric code, or *op code*. The computer can execute an assembly-language program only after it has been processed by the assembler.

Q: Why not just write programs using the number codes in the first place? Then you wouldn't need the assembler.

A: Some people do it that way. But it's much easier to remember JZ than 120. The assembler also takes care of a few other things. You aren't required to use an assembler; it just makes life a littler simpler.



Fig. 2. A cross compiler accepts a source program and then compiles it for another computer.

Q: But not as simple as when you use a high-level language such as BASIC or Pascal?

A: True.

Q: What's a macro assembler? Is that the same as a regular assembler?

A: It's a more versatile kind of assembler. A macro assembler, in effect, lets you define your own instruction mnemonics. A macro is a sequence of program instructions that the macro assembler treats as a single instruction. You might, for example, write a macro that calculates square roots and label it SQRT. In a program you could then use SQRT as if it were an ordinary mnemonic. The macro assembler, when processing the program, would replace all references to SQRT with your original instruction sequence.

Q: I guess a disassembler is the opposite of an assembler.

A: That's right. A disassembler converts machine language—the numeric representation of an assembly-language program—back into assembly language.

Q: I just thought of something. If my computer can understand only the number codes of machine language, how can it understand programming languages, such as BASIC and Pascal?

A: Programs written in high-level languages are translated so that the computer can execute them. The translation is performed by special machine-language programs called language processors.

Q: How are they translated?

A: There are two primary types of language processors: compilers and interpreters (see Fig. 1). A compiler converts programs into machine-language form. To run a program that has been compiled, the computer simply executes the machine-language version that the compiler generated.

An interpreter accepts high-level language programs in their original form and executes them without modifying them. It analyzes the program text during execution, identifying verbs and variables and performing the directed operations.

Q: Which approach is better?

A: There are advantages to both. Compiled programs are faster, because the computer doesn't spend time during execution on analysis of the program. Interpretive systems are typically ten to 100 times slower.

On the other hand, interpreters are more convenient. A program can be run immediately after it is entered with no intervening compilation stage. This is especially helpful during program development. Some interpreters also include features that ease the process of tracking down programming errors, or bugs.

Q: Why couldn't you use an interpreter when you're writing a program, and then compile it after you've gotten all the bugs out?

A: You could, theoretically. But few computers have both an interpreter and a compiler for the same language.

Hybrid interpreter-compilers, or pseudo compilers, are a frequently used compromise. These compile the original program into an intermediate form between machine language and high-level language. The resulting program is handled by an interpreter at run time. This approach is faster than an interpreter but slower than a pure compiler. It also provides much of the run-time control of an interpretive system.

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```
10  PRINT A(C + 3)
20  A(C + 3) = A(C + 3) + 1
30  GOTO 500
```

Fig. 3a. These calculations are redundant. A compiler could replace them with a single calculation of A(C + 3).

```
100  FOR X = 1 TO 10
110  I = Q • 1.7
120  A(X) = I
130  NEXT X
```

Fig. 3b. This calculation, because it is within the loop, will be repeated ten times. A compiler might move it to a position before line 100, because it will not vary as the loop progresses.

Pascal is normally processed this way. First a Pascal program is compiled into an intermediate language called p-code. The p-code version may then be either interpreted or compiled further into machine language.

Q: You say that language processors are machine-language programs. In that case, it seems as though a language processor could be written in a high-level language, Pascal, for example, and then compiled. That would be a lot easier than writing it in machine language or assembly language.

A: You aren't the first to have that idea. It's quite a common practice, in fact. For example, a version of BASIC for 8080 microcomputers called BASIC-E was originally written in a language called PL/M. The CP/M operating system was also a PL/M program once. After these programs were written, their authors used a PL/M compiler to generate machine-language versions for the 8080.

Q: Why PL/M?

A: PL/M is in a class of languages called *systems languages*. These are specialized for use in the development of programs such as compilers and interpreters. PL/M is available for several microprocessors, including the 8080, the Z-80, the 6800 and the 2650.

An interesting point about PL/M is that it is normally implemented as a cross compiler (see Fig. 2). In other words, it runs on one computer but generates machine code for another type of computer altogether. You could run PL/M on a big IBM computer, for example, and have it compile programs that would run on the Z-80.

Q: Is there any such thing as a "cross assembler"?

A: Yes, indeed. A cross assembler works the same way as a cross compiler. You could, for example, run a 6502 cross assembler on a Data General minicomputer.

Q: What's the advantage of cross assemblers and cross compilers? Why not just run PL/M for the Z-80 on a Z-80? Why not just run an assembler for the 6502 on a 6502?

A: Microcomputer systems are sometimes inadequate for this type of work. First, assemblers and compilers often require vast amounts of computer memory space. Second, micros are slower than larger computers. Third, programs such as PL/M or an assembler are easier to write for a larger computer.

Q: When a compiler processes a program, does it scan the program only once?

A: That varies. Most compilers read through programs several times before the machine-language version is generated. On the first pass, the compiler will typically collect such information as variable names used, functions accessed and branching references. During subsequent passes the compiler might clean up, or *optimize*, the program. That is, it attempts to detect wasteful programming.

Q: What optimizations does it perform?

A: That varies, too. Sometimes the compiler will look for mathematical formulas that are repeated. If it can, the compiler will set up the compiled program so that these redundant calculations are performed only once.

Another common optimization is the elimination of unreachable program segments. If the compiler finds that a certain series of instructions is never used during program execution, those instructions will be omitted from the compiled program (see Fig. 3).

Q: Compilers sound very complicated.

A: They are. Fortunately, you and I can use them without necessarily understanding their inner workings.

Incidentally, programmers have technical names for the original program and the machine-language program generated by the compiler (or assembler). The former is called the source program; the latter is called the object program. Also, computer whizzes like to describe assemblers and compilers by the number of readings or passes they make of a source program. Thus, we might refer to a two-pass assembler or a one-pass compiler.

Q: Do hobbyists ever write their own language processors?

A: Occasionally. One recent focal point of interest in this area was the Tiny BASIC project. Encouraged with moral and technical support from a computer magazine, several computer hobbyists wrote their own interpreters for a minimal subset of BASIC called Tiny BASIC.

Q: I'd like to use my microcomputer as a teaching tool. Are there any special languages that I can use to write programs for computer-assisted instruction?

A: There are several. Only one of them, however, is widely available for microcomputers. That language is PILOT. It is easy to use and inexpensive. A general-purpose language, such as BASIC, would also be suitable for this type of work.

Q: I guess I'm about ready to wrap up for now. Any last thoughts?

A: Yes, if you are cowed by programming languages and programming in general, remember that these languages are here to help, not hinder, you. Their function is to help you formulate your thoughts in a way that your computer understands. ■

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What! Another Kansas City Interface

That's right!

William A. Gordon
Southwest Microsystems
6803 Kings Point Ln.
Austin TX 78723

Most Kansas City Standard (KCS) audio cassette interface implementations you read about produce a receive clock that operates at 16 times the data bit rate (usually 300 baud). This receive clock is used by an asynchronous communications interface such as a UART or a programmable version such as the Motorola MC6850 Asynchronous Communications Interface Adapter (ACIA). The KCS interface to be described in the article, the BG-KCS interface to a Motorola MEX6800D2 (D2 kit) two-board computer (see Photo 1), assumes the use of an ACIA or similar serial port.

The Motorola ACIA may be software programmed to utilize a receive clock rate of 64, 16 or 1 times the received data rate. For the 64× or 16× modes, the ACIA internally synchronizes the received data and received clock. For the 1× mode, however, the clock/data synchronization must be done externally. That is, the user must implement logic that will perform this necessary synchronization.

The 1× clock mode was designed to be used in those instances where both the clock and data signals are transmitted separately. For instance, the D2 kit has a KCS interface that uses the 1× receive mode of the ACIA.

The new TVBUG monitor ROM, recently introduced by Motorola (in the MC6846 package), requires a 1× receive clock for the serial port used in its 300 baud KCS interface. Also, the new CRTBUG monitor again uses the 1× receive mode as part of its ACIA initialization routine for loading KCS tapes. It looks as though Motorola will be using the 1× receive mode for many of its future monitor ROMs that require a KCS interface.

Now, how do we produce our KCS transmit/recovery interface to operate with an ACIA configured with a 1× clock? There are two common approaches. One takes the famous Lancaster KCS interface (well known by its liberal use of CMOS exclusive OR gates and one-transistor one-shot) and "doctors" it up a little bit (see "Build the Bit Bof-

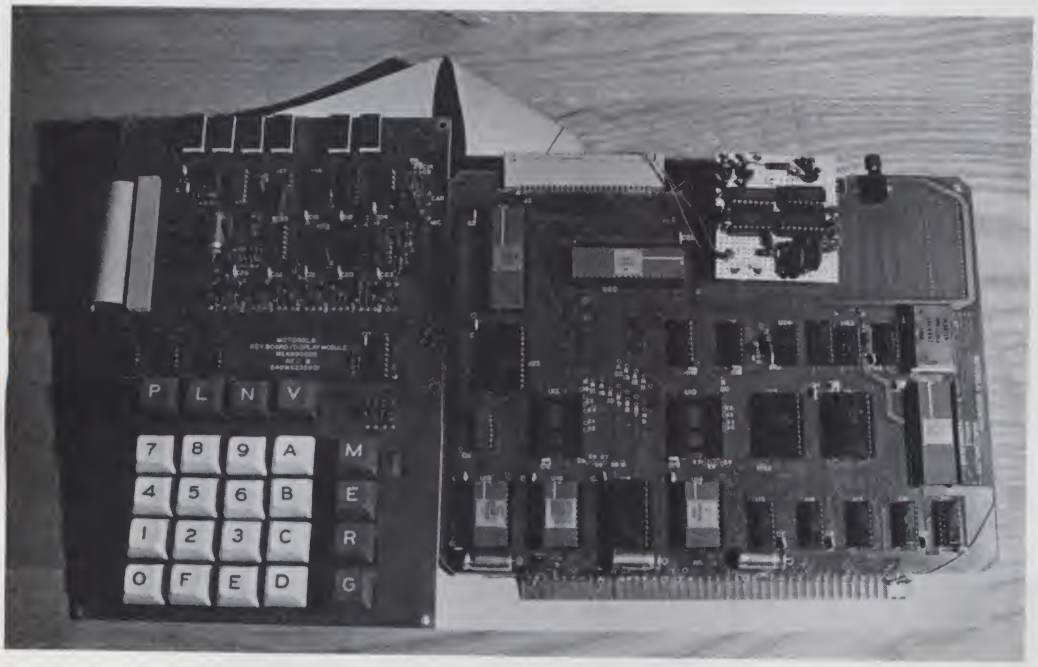


Photo 1. The simplified Kansas City Standard tape interface, the BG-KCS, is mounted in the wire-wrap area of the author's D2 kit.

fer" by Don Lancaster, *Byte*, March 1976, p. 30). This interface was designed to supply a 16× receive clock to a UART or ACIA. Typically, you can divide this clock by 16 with a relatively expensive MC14040 12-bit counter; with this approach you usually can get the parts count down to about six ICs.

The other approach is to design "from the ground up" an interface based on specific 1× design criteria defined at the outset. By taking this approach you realize a considerable savings in printed circuit board real estate with a 4-IC interface design as shown in Photo 2.

Schematic Description

To describe how the simple BG-KCS interface works, we'll look separately at the recovery and transmit functions. There is one IC that is used for both the receive clock and the transmit synchronizer/data transmitter. Both sections of the KCS utilize the RTS signal for proper configuration of the interface.

The recovery circuitry begins with the output of the tape recorder feeding into the transistor limiter Q3. An idealized representation of the output of Q3 is shown in Fig. 1a. This limiter expects to see a minimum of approximately 1.8 volts peak-to-peak input. Most tape recorders have no problem supplying the required voltage levels for this interface. The output of the limiter is a rectangular waveform whose duty cycle is a function of the amplitude of the input signal level. The Q3 output is shown in Fig. 1b.

In order to eliminate the effects of duty cycle variations, the output of Q3 is fed to the input of a one-shot, MC14538, U2a. The MC14538 is set up to trigger on the rising edge of the Q3 output. The output of U2a is a narrow pulse width spike represented in Fig. 1c. This output is used to drive two inputs.

The falling edge of the spike is used to trigger one-shot U2b. This section is set up in a nonretriggerable mode, with a period equal to that of a 1600 Hz waveform (625 microseconds). The output of this one-shot is shown in Fig. 1d. You should carefully adjust U2b for this value.

This one-shot output is an asymmetrical rectangular waveform of 75 percent duty cycle, with a frequency equal to 1200 Hz nominal. Any pulse that is input to the one-shot during its active period is ignored.

Also notice that 1600 Hz is exactly 33 percent higher than 1200 Hz (zero) and 33 percent below 2400 Hz (one). The speed variations tolerated by the BG-KCS are shown in Fig. 2. Ignoring other error-producing effects such as bias distortion and jitter, you could theoretically expect this interface to work over a +33 percent to −33 percent tape-speed variation assuming a linear tape speed vs frequency function.

The rising edge of the U2b output clocks both the D flip-flop U3a and the J-K flip-flop, U1a, via multiplexer U4b. Flip-flop U3a outputs the value of its D input (logic one) once each rising edge of the 1200 Hz clock, except when reset by the condition that outputs C and D are both high. This logical AND function is implemented with a transmission gate rather than the usual AND gate functions found in IC packages such as the 7408 or MC14081. The output of U3a is shown in Fig. 1e.

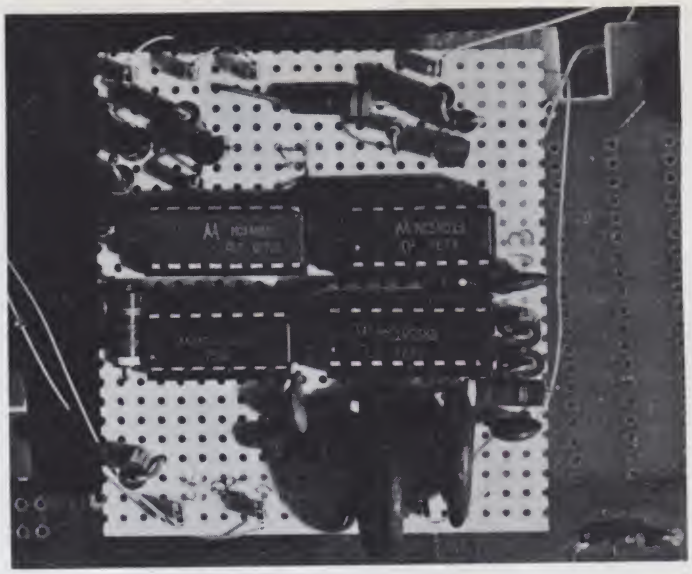


Photo 2. Compact layout and low IC count of the BG-KCS.

The trailing edge of U2b clocks the D-flop U3b. The data input, D, connected to the Q output of U3a is clocked out on the falling edge of the 1200 Hz clock. Whenever a 2400 Hz signal is received, the input to the D-flop, U3b, is low during the falling edge of the 1200 Hz clock. Therefore, a logic zero is clocked out on the Q output of U3b. When a 1200 Hz signal is received, the input to the D-flop U3b is always high; therefore, a high is clocked out of the Q output of U3b. The true data exists on the negated Q output (Q) of U3b.

The clock recovery circuit is also easy to implement. The only difficulty stems from the positioning of the clock pulse such that the rising edge of the clock pulse occurs as close as possible to the center of the data bit period as shown in Fig. 3. This is done by using U1a and U1b as a synchronous divide-by-four counter. The divide-by-four function is implemented by making J and K high on U1a and tying the Q output of U1a to the J and K inputs of U1b. You just have to pick off the appropriate outputs of U1a and U1b to decode the third count of the counter.

The receive clock is obtained by performing a logical AND of the Q output of U1a and the Q output of U1b. Again, a transmission gate is used as an AND gate. The resistor, R11 (as well as R5), is used as a "bleeder" resistor for unwanted, stored charges at the output node of the transmission gate. The rising edge of the third count will occur in the middle of the data bit period, provided the counter U1 starts in its initial state at the beginning of the data bit period.

We can assure this proper initialization of the U1 counter by performing a reset on U1 when a high-to-low data transition occurs. It is fortunate that the KCS requires a "leader" of 2400 Hz (for about 5 seconds or more, for recorder AGC level stabilization)

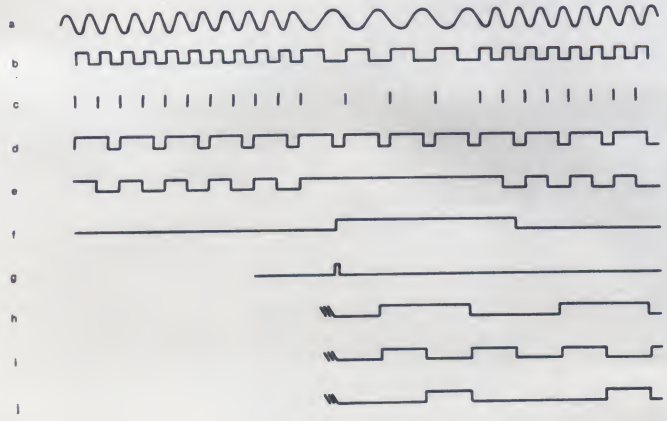


Fig. 1. BG-KCS recovery timing.



Fig. 2. Pictorial description of tape-speed variations.

before data is transmitted.

At the beginning of data transmission, a start bit (logic zero) is transmitted. The transition from the leader to the start bit is our required counter initialization transition. This reset pulse is derived by the differentiator R6-C3. The reset pulse is represented in Fig. 1g and has a pulse width of about 100 ns. The diode D2 is used to eliminate any possible negative pulses occurring as a result of the differentiation process.

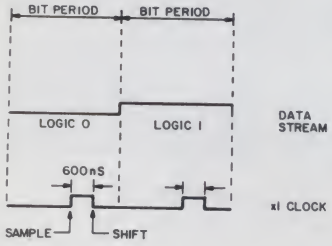


Fig. 3. Sample/shift timing in 1× mode. Shift should occur before the end of current data bit period. Sample should occur as close as possible to the center of the data bit period.

The RTS signal from the ACIA tells the KCS interface to configure itself for transmit or receive. In the receive mode, RTS = 0, as defined by the I/O initialization routine of the ROM monitor. In this mode, the RTS signal is inverted by Q2 and applied to the gate of U4b. This allows the 1200 Hz clock to pass to the divide-by-four counter and effectively disables the 4800 Hz transmit clock.

Also, RTS performs one more function in the receive mode. The collector of the transistor Q2 goes high, which reverse-biases the base emitter junction of Q1. This allows no current to flow in the collector of Q1; consequently, the collector of Q1 goes high, as is necessary for U1 in the receive mode.

This little trick was necessary to avoid using another IC package (AND gates), since when transmitting, TXD must be inverted before being applied to the J input of U1a. Unfortunately, TXD is high (idle mark) when in the receive mode, and if inverted, a logic zero would always be applied to the J input while receiving, whereas the J input of U1a must be high as stated before.

The transmit section of this KCS interface is simple. A 4800 Hz stable clock, preferably derived from a crystal-controlled time base, is simply divided by two or four for a TXD data level of one or zero, respectively.

The important aspect of the scheme is that by using two J-K flip-flops in a synchronous counter configuration, the transition between 1200 Hz and 2400 Hz will occur at zero crossings and produce no spurious spikes that plague a number of D-flop counter configurations.

The 1200 Hz or 2400 Hz square waves are low-pass filtered to be presented to the input of an ordinary tape recorder. The low-pass filtering makes the square wave more like a sine wave. For reasons too lengthy to discuss here, audio tape recorders reproduce sine waves more faithfully than they do square waves.

A voltage divider is employed so that you can record using the auxiliary input of your tape recorder, provided it has such an input. The auxiliary input provides for better signal-to-noise ratio recording. If your recorder has only a microphone input, then you must connect to the microphone output of the KCS interface, since the auxiliary output will overload the microphone input.

In order that your KCS takes full advantage of tape-speed variation tolerance, the period of the one-shot J2b must be adjusted for a period equal to the period occupied by a 1600 Hz repetitive waveform. The simplest way to accomplish this is to connect a calibrated, stable, 3.5 volt 1600 Hz sine wave or square wave source to the tape input and adjust R4 until the DATA output of U3b changes state. The resistor R4 should remain set at this transition point.

For data recovery, it may be necessary sometimes to reverse the signal and ground leads of some tape recorders to effect a 180 degree phase reversal to the KCS input network. You will be able to tell if this is necessary by determining if it is possible to store and retrieve data. If not, reverse the output leads. If you have no luck after this, check your wiring.

The Kansas City Standard/ ACIA Connection

What is the Kansas City Standard (KCS)? A conference was held in Kansas City MO on November 7 and 8, 1975, to develop a standard for data recording and recovery. In this standard each data bit corresponds to a tone burst of particular frequency. A logic one is represented by eight full cycles of 2400 Hz, and logic zero is represented by four full cycles of 1200 Hz.

Notice that both a logic one and a logic zero occupy the same amount of real time in any bit stream. In fact, since there are four complete cycles of 1200 Hz, the "bit period" is 1200 Hz/4, or 300 Hz. So the data rate in this instance is 300 bits/second, or 27 bytes/second.

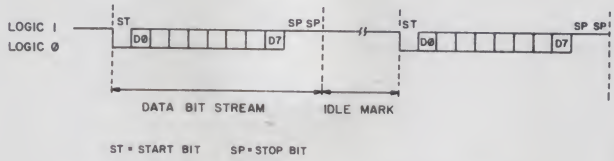


Fig. 4. Asynchronous serial data transmission.

Furthermore, it was decided that the data should be transmitted and received in an asynchronous fashion. The structure of data transmission is shown in Fig. 4. Notice that each data byte transmission begins with a start bit of logic zero (ST) and ends with two stop bits of logic one (SP).

The fact that each byte ends with at least one stop bit (two stop bits, in this case) ensures that each data byte will be preceded by a one-to-zero transition. This one-to-zero transition is utilized by this interface to maintain receive clock synchronization with received data.

This brief examination of the KCS should help you understand the basis on which the BG-KCS interface was constructed. This interface was designed primarily to interface to a Motorola MC6850 ACIA. A more detailed description of the ACIA can be found in data sheets published by the manufacturer.

ACIA Control and Signal Lines

Transmit clock (TXC) is an input to the ACIA, which is used to transmit data on the negative edge of the transmit clock. This transmit clock generally derives from a baud rate generator such as the MC14411 usually contained as part of the MPU system. In this case, the transmit circuitry of the ACIA uses a 16× clock of 4800 Hz to transmit at 300 baud. This 4800 Hz signal is synchronously divided by 2 or 4 to transmit to the tape recorder 2400 Hz or 1200 Hz to represent a 1 or 0, respectively.

Transmit data (TXD) is the output signal generated by the ACIA corresponding to the parallel data input by the MPU. The baud rate at which data is transmitted is determined by the transmit clock divided by 1, 16 or 64. Here, again, the division constant is determined by the ACIA initialization routine contained in the monitor ROM.

The receive clock (RXC) is an input normally used for synchronization of received data and receive clock, and is derived from the recorded data in this application.

In the 1× receive mode, the synchronization must be done externally. The clock signal derived from the tape recorder will track tape-speed variations within given limits. This self-clocking feature of the KCS interface receive circuitry makes it suitable for reliable hobbyist usage.

Receive data (RXD) is used to input externally received data to the ACIA. Here, the data is recovered from the tape by the KCS interface. It is important to note that the RXD signal is synchronized to RXC by the KCS interface, as it should be for reliable data reception.

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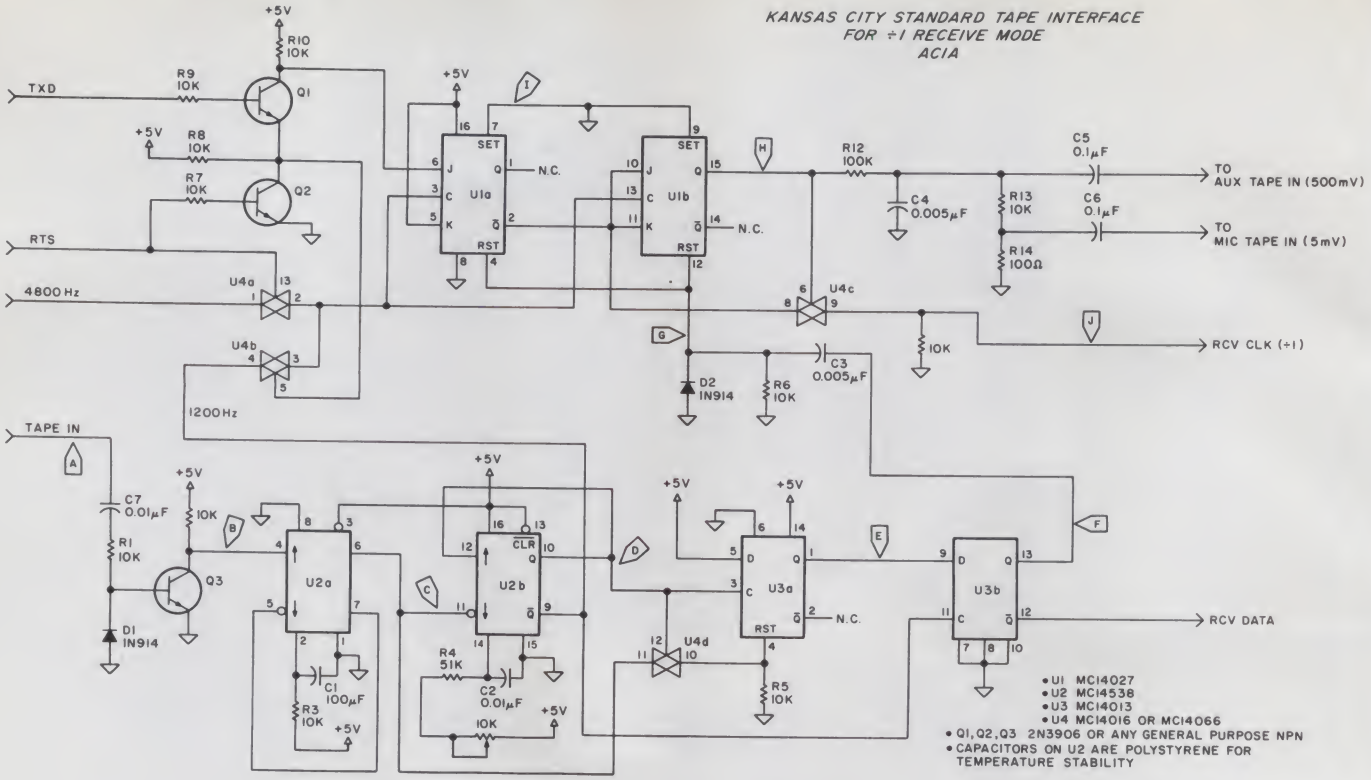


Fig. 5. BG-KCS interface schematic.

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The request to send signal (RTS) is an output used to properly configure the KCS interface in the receive or transmit mode. This output can be software configured to indicate transmit or receive data conditions of the ACIA. In this case, RTS = 0 indicates receive, and RTS = 1 indicates transmit.

In the 1× receive mode, the ACIA samples its data input RXD on the rising edge of the receive clock and shifts data in parallel form to its parallel read register on the falling edge of the receive clock. There has to be some minimum time between sample and shift (600 ns), which is met by the BG-KCS interface clock.

Fig. 3 illustrates the sampling technique of our KCS interface receive clock. Note that the rising edge of the receive clock appears in the middle of the data bit period for maximum immunity to bias distortion, jitter and tape dropout. The width of the pulse was chosen so that one cycle of 1200 Hz could drop out, and "good" data would still be recovered.

Let's now see just how we can implement a KCS interface that is (1) inexpensive, (2) uses stock CMOS ICs, (3) is reliable and (4) has a low parts count.

Conclusion

A reliable, low-cost, low parts count KCS interface for the 1× receive mode of an ACIA has been presented. This interface has been successfully used with the MEK6800D2 kit. Since the new TVBUG and CRTBUG monitor ROMs have the same ACIA initialization routines as that of the D2 kit JBUG monitor, this KCS interface should work quite well with TVBUG and CRTBUG systems as well.

A wide variety of tape recorders have been used in the evaluation of the BG-KCS interface and found to operate quite well with all of them. Occasionally, the polarity of the tape signal to the recovery input must be reversed for proper operation. Transportability of tape between different recorders is excellent. The BG-KCS will tolerate tape-speed variations from +33 percent to −33 percent for a given tape recorder, and the input signal overload characteristics are also excellent. ■

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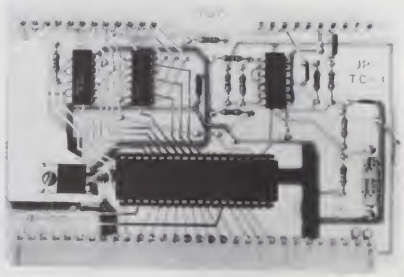
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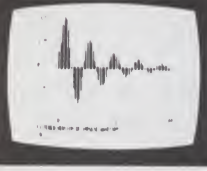
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07 = ENTER/UPDATE ORDERS
08 = ENTER/UPDATE BANKS
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11 = EXAMINE/PRINT INCOMPLETE RECORDS
12 = EXAMINE PRODUCT SALES

SELECT FUNCTION BY NUMBER

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15 = PRINT AGENT STATEMENTS
16 = PRINT TAX STATEMENTS
17 = PRINT WEEK/MONTH SALES
18 = PRINT WEEK/MONTH PURCHASES
19 = PRINT YEAR AUDIT
20 = PRINT PROFIT/LOSS ACCOUNT
21 = UPDATE END MONTH FILES
22 = PRINT CASH FLOW FORECAST
23 = ENTER/UPDATE PAYROLL (NOT YET AVAILABLE)
24 = RETURN TO BASIC

WHICH ONE? (ENTER 1-24)

Each program goes to sub menu, e.g.:
(9) allows A. LIST ALL SALES; B. MONITOR SALES BY STOCK CODES;
C. RETRIEVE INVOICE DETAILS; D. AMEND LEDGER FILES;
E. LIST TOTAL ALL SALES.

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- auto check to prevent double entry with file management system dynamically allocating information for minimum disk space consumption.
- Auto invoice numbering (with override option), plus auto printout integrated with stock and address files for payment term discount, agent allocation, price index retrieval and auto stock update; nominal codes retrieved from address files may be optionally overridden.
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Reader Service—see page 257

Evolution of a Cassette-Based SWTP 6800

For those who want speedy mass storage without paying "disk dollars."

Chesley H. Looney
3406 Notre Dame St.
Hyattsville MD 20783

In October 1977, I purchased a CT-64 terminal kit from Southwest Technical Products. In November, I added a Pennywhistle modem and was then able to do some programming and program checkout at home.

This experience simply whetted my appetite for my own personal computer, so, in May 1978, I purchased an SWTP 6800/2 and the Micro S-1 printer by Centronics. By July, I had become frustrated by working only with machine code and purchased the Micro BASIC Plus interpreter by Technical Systems Consultants (TSC). The horizons then really began to expand. My 15-year-old son and I became avid readers of the various computer magazines and anxiously awaited the next issues' new game listings to try out and place in our tape library.

Introduction

Since the Pennywhistle is designed to permit cassette recording in the same format as RS-232 ASCII telephone computer information exchange protocol, we used the RS-232 format rather than the slower Kansas City Standard.

Our current cassette-based system now uses the JPC high-speed cassette interface and file manager, together with a modified SWTBUG monitor and TSC 6800 BASIC interpreter. This combination has permitted a dramatic increase in speed of access to the taped data, so we have no need for a disk system. The modifications to the SWTBUG and the methods of using the JPC products may be of interest to others who would like disk-competitive speeds without disk-based dollar investments.

From a cold start, I am able to strike one key and start the following sequence, which proceeds automatically. First, the read utility is loaded into the computer through the 300 baud RS-232 interface. Second, the file manager is loaded via the 4800 baud JPC interface. Third, the TSC 6800 BASIC is loaded and started. The process takes less than a minute and only requires loading a cassette and typing the letter "T." No switching or cable interchanging is required.

Tape Speeds

The small BASIC interpreter's lack of string-handling routines and exponential and transcendental function capability and its limitation to integer arithmetic became more and more of a roadblock to our desired activity. So, in September 1978, I installed a Computerware (CSS) BASIC interpreter on PROM, along with an additional serial interface board. The capability of this interpreter is substantial in both math and formatting abilities.

The tape speed increased by a factor of three, due to the CSS interpreter's I/O use of ASCII text rather than the hex dump approach used by the small BASIC interpreter.

The SWTBUG monitor in the SWTP computer is based on the MIKBUG originally produced by Motorola and uses a hex dump format to output data or accept input data. The Kansas City Standard uses the same format for cassettes.

In essence, a line of data includes a recognition code (S1), followed by a hex count of the number of bytes in the line to be sent as output or accepted as input. The next two bytes provide the hex address of the location for the first data byte in the line to follow. The data in the line is then transmitted and ended with a checksum byte. Therefore, for a line of 16 (hex 10) bytes of data, 42 actual characters, plus returns, line feeds and nulls, are transmitted.

The analysis provided with the JPC high-speed cassette interface states that an effective transmission speed of only 85 baud is achieved when using this hex format on a 300 baud line. The ASCII or RS-232 protocol more nearly realizes the 300 baud transmission rate; therefore, when we changed from the hex-dump approach with the small BASIC interpreter to the ASCII approach with the CSS interpreter, our data capacity per cassette more than doubled. More important, the time required to read or write a file was less than half its earlier value.

I was unaware of the approximately three-to-one speed difference between ASCII and Kansas City Standard formats prior to changing to the CSS interpreter. It appears to me that the RS-232/ASCII format would be preferable to the Kansas City Standard for information transfer because of its increased speed and compatibility with the ASCII standard. Using the ASCII standard permits a terminal and acoustic coupler combination to read stored cassette tapes played on a small, portable cassette player as though the signal is coming from a computer through an RS-232 interface.

Installing the Hardware

At this point, we had a full-featured BASIC capable of just about everything but matrix

```
LOCN B1 B2 B3
0000            >*****************************************
0000            >*  TC-3 UTILITY PROGRAM AS DELIVERED    *
0000            >*  FROM $0000 THROUGH $006D; MOVED      *
0000            >*  TO $A5B0 THROUGH $A61D WITH THE      *
0000            >*  FOLLOWING CHANGE AND ADDITIONS       *
0000            >*****************************************
0000            >
0000            >*  DEFINITIONS:
0000            >
A780            >CFM3 EQU  $A780   ENTRY FOR CFM/3 FILE MANAGER
AFFF            >CFME EQU  $AFFF   CFM/3 LAST MEMORY LOCATION
A5B2            >UTLD EQU  $A5B2   TC-3 READ (LOAD) ENTRY POINT
E337            >RON3 EQU  $E337   SWTBUG RDON+3; TURNS RECORDER ON
A002            >BEGA EQU  $A002   SWTBUG BEGINNING ADDRESS
A004            >ENDA EQU  $A004   SWTBUG ENDING ADDRESS
0000            >
0000            >*  CHANGE:
0000            >
A5E4            >      ORG  $A5E4
A5E4 7E A7 80   >      JMP  CFM3   JUMPS TO CFM/3 AFTER LOADING
A5E7            >
A5E7            >*  ADDITIONS:
A5E7            >
A61E            >      ORG  $A61E
A61E BD E3 37   >CFMU JSR  RON3   ENTRY TO START CFM LOAD PROCESS
A621 CE A7 80   >      LDX  #CFM3
A624 FF A0 02   >      STX  BEGA
A627 CE AF FF   >      LDX  #CFME
A62A FF A0 04   >      STX  ENDA
A62D 7E A5 B2   >      JMP  UTLD
A630            >
A630            >      END
*** UNRESOLVED:
*** SYMBOLS?
Y
BEGA A002  CFM3 A780  CFME AFFF  CFMU A61E  ENDA A004
RON3 E337  UTLD A5B2
```

Listing 1. Modified read utility.

arithmetic; our cassettes were packed three times as full; and the second serial interface was installed to permit printer and modem operation on a 300 baud port (port 2) while leaving the terminal on the 1200 baud control port (port 1). The only problem was that we wanted to use some of the machine-language programs, which were in the hex dump format, thus taking quite a while to load.

In order to reduce this time, I installed the TC-3 high-speed interface produced by JPC Products Company. When I tried to get it to work, I found (as JPC had advised) that my portable cassette player would not handle the high-frequency requirements of 4800 baud transmission. I bought a Radio Shack SCT-12 stereo deck and found I'd obtained a bonus: capability of handling the 300 baud signals on one channel and the 4800 baud data on the other channel!

After a bit of operator shakedown to learn the protocol and commands, the TC-3 and the SCT-12 worked beautifully. The next step was to install a motor control module to permit the computer to turn the recorder on and off. This was not difficult since the CT-64 provides decoded control signals. The circuit in Fig. 1 uses these signals to turn the recorder motor on or off upon receipt of Control-Q/Control-S (read on/off) or Control-R/Control-T (record on/off) signals.

Most inexpensive recorders have jacks for "remote" control of the motor; however, the SCT-12 does not have that feature, so I had to install the necessary jack. The motor red lead is easily located and lifted from a printed circuit board from which it receives switched + 12 volts. Connecting another lead to the board and bringing this lead and the motor lead to a new jack installed on the back panel of the SCT-12 is only about a half-hour job.

The parts for the circuit in Fig. 1 are inexpensive and not critical as to value or transistor type. Total cost of the TC-3/SCT-12 system, including the start-stop circuit, is well under $150.

One cautionary note: Radio Shack's warranty will be voided if the recorder is modified. Be prepared to pay for any repairs —whether or not they are related to the modification—if the recorder fails to operate satisfactorily after the modification is made. If you do not wish to make your own motor control kit, JPC now offers one (TS-11 motor control kit) for $4.95, and they offer free advice on motor control if you send a self-addressed stamped envelope (JPC Products, PO Box 5615, Albuquerque NM 87185).

Using the TC-3 interface required first getting a utility read/write routine into the computer memory. I had to record this routine at the beginning of a cassette and load it before each computer session. From then on, all data in and out went through the high-speed interface and took less than one-tenth the time earlier required with the ASCII protocol.

Putting the utility in manually for each session and looking up the start/stop locations of each segment to be recorded proved to be annoying. Although the CSS BASIC interpreter was generally satisfactory, its use with the TC-3 created a problem: where to put the utility? The CSS BASIC uses all of the direct page of memory and automatically reserves all memory to the end of the contiguous sections for program or variable use.

In order to solve the annoyance of manual file management, I bought a copy of JPC's file manager CFM/3. It helped to increase ease of file management, but also provided some unexpected benefits: the ability to move segments of code, to verify correct recording, to compare different sections of stored programs and to dump ASCII-decoded hex data.

The CFM/3 with its writer also reduced the time to load the utility before each session. Now the slow speed input need only be used to load the read portion of the utility along with a recorder turn-on command and the beginning and ending addresses for the file manager's reserved memory location.

Although the CSS BASIC interpreter worked well, I wanted to install the new high-speed interpreter from TSC, but it would need 10K of RAM! So I bought a Gimix 16K RAM board.

Installing more memory required leaving SWTP's 8K of memory at locations $0000 to $1FFF. Gimix's first 12K of memory is addressed from $2000 to $4FFF, and the remaining 4K is addressed from $A000 to $AFFF, retiring the 128 bytes of RAM that came with the SWTP 6800.

The CSS interpreter can now run up to $4FFF and leave the section from $A000 to $AFFF undisturbed. I hand-assembled the file manager and modified it to remove user commands and then placed it in the section from $A780 to $AFFF, leaving $A000 to $A07F for the computer and $A080 to $A77F for the user.

Software

Now I had to link all the desired routines to simplify start-up of the system. As delivered, the TC-3 interface comes with a machine-language utility to read or write through the high-speed module connected to port 4. This two-routine utility is relocatable and jumps to the SWT-

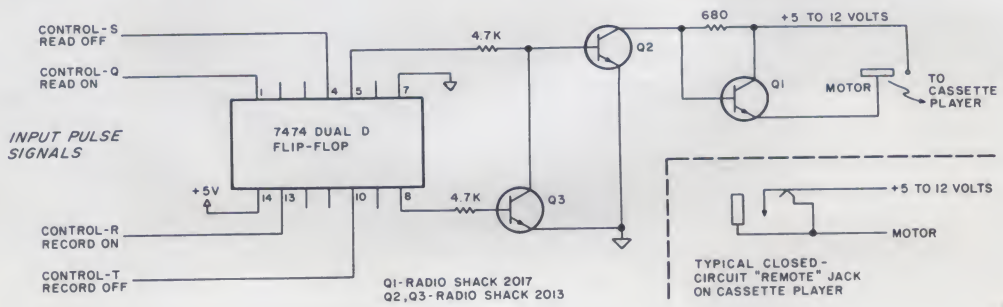


Fig. 1. Motor control circuit.

BUG monitor control at $E0E3 at the end of either the read or the write operation.

The first modification was to separate the two routines, use only the read routine and change the final jump command to go to the CFM/3 entry point. I added commands to turn on the recorder and load the SWTBUG monitor start and stop addresses with the beginning and ending addresses of the file manager (see Listing 1). I recorded the modified read utility at the beginning of each tape followed by the "E" end-of-tape command with $A61E stored in $A048-49 to prepare for using "G" to start the high-speed reading operation.

Normal operation of the SWTBUG with the read routine and CFM on tape requires typing "L" to load the read routine; then, when the "$" prompt appears, the letter "G" is typed to run the high-speed loading operation. Initial preparation of the tape requires the use of the utility write routine, so the complete TC-3 utility is maintained as a cassette file for use when needed.

The TSC 6800 BASIC interpreter proved to be a fast operator but difficult to embed in my system due to unavailable source code and the pseudo-compilation nature of this interpreter. My first approach was simply to store the interpreter along with the program desired to save; however, this took a lot of unnecessary time due to the repetitive storage of the 10K interpreter.

JPC forwarded their patches to link the TSC interpreter with their CFM file manager, and it was now possible to SAVE files with the BASIC command SAVE, FILENAME. The linked BASIC and CFM routines automatically set the start and stop addresses and write the identification segment and source to tape. All the necessary BASIC housekeeping of the tokens and flags is taken care of automatically.

I now wanted to modify the SWTBUG monitor in order to simplify and connect the three operations: the loading of the TC-3 read utility, high-speed loading of the CFM file manager and high-speed loading of the BASIC interpreter. Listings 2, 3 and 4 provide details of the desired SWTBUG modifications.

The principal modification is to provide a loading subroutine so that the SWTBUG monitor will return to a user program rather than to CONTROL ($E0E3) upon completing a load operation.

I also wanted this new subroutine to expect input through port 2 and restore the system to port 1 after loading the data. This would involve changing the

```
LOCN B1 B2 B3
0000           >*********************************************
0000           >*  FIRST PATCH TO SWTBUG - CHANGES LOAD *
0000           >*           ROUTINE TO A SUBROUTINE          *
0000           >*********************************************
0000           >
0000           >*  DEFINITIONS:
0000           >
E078           >INCH EQU  $E078  CHARACTER INPUT SUBROUTINE
A00F           >CKSM EQU  $A00F  CHECKSUM
E055           >BYTE EQU  $E055  BYTE INPUT SUBROUTINE
A047           >BYCT EQU  $A047  BYTE COUNT
E047           >BADR EQU  $E047  BUILD ADDRESS SUBROUTINE
E2B0           >ERRR EQU  $E2B0  OUTPUTS '?' AND JUMPS TO CONTROL
0000           >
0000           >*  PROGRAM PATCH:
0000           >
E00C           >     ORG  $E00C
E00C           >
E00C 8D 6A     >LOD1 BSR  INCH
E00E 81 53     >     CMPA #'S
E010 26 FA     >     BNE  LOD1    WAIT FOR AN S
E012 8D 64     >     BSR  INCH
E014 81 39     >     CMPA #'9     END FOR AN S9
E016 27 00     >     BEQ  LEND
E018 81 31     >     CMPA #'1     WAIT FOR AN S1
E01A 26 F0     >     BNE  LOD1
E01C 7F A0 0F  >     CLR  CKSM
E01F 8D 34     >     BSR  BYTE
E021 80 02     >     SUBA #2
E023 B7 A0 47  >     STAA BYCT
E026 8D 1F     >     BSR  BADR
E028 8D 2B     >L011 BSR  BYTE    LIKE OLD LOAD11
E02A 7A A0 47  >     DEC  BYCT
E02D 27 00     >     BEQ  L015
E02F A7 00     >     STAA 0,X
E031 A1 00     >     CMPA 0,X
E033 26 00     >     BNE  L019    GO ERRR FOR ERRORS
E035 08        >     INX
E036 20 F0     >     BRA  L011
E038 7C A0 0F  >L015 INC  CKSM    LIKE OLD LOAD15
E02E 09
E03B 27 CF     >     BEQ  LOD1
E03D 7E E2 B0  >L019 JMP  ERRR    LIKE OLD LOAD19; PRINT '?'; JUMP TO CONTROL
E034 08
E040 39        >LEND RTS
E017 28
E041           >
E041           >     END
*** UNRESOLVED:
*** SYMBOLS?
Y
BADR E047  BYCT A047  BYTE E055  CKSM A00F  ERRR E2B0
INCH E078  LEND E040  L011 E028  L015 E038  L019 E03D
LOAD E00C
```

Listing 2.

```
LOCN B1 B2 B3
0000           >*********************************************
0000           >*  SECOND PATCH TO SWTBUG - CHANGES DISK  *
0000           >*          BOOT TO CASSETTE TAPE BOOT         *
0000           >*********************************************
0000           >
0000           >*  DEFINITIONS:
0000           >
E00C           >LOD1 EQU  $E00C  LOAD SUBROUTINE
E334           >RDON EQU  $E334  TURNS RECORDER ON, ETC.
E2D4           >RDOF EQU  $E2D4  TURNS RECORDER OFF; JUMPS TO CONTROL
8004           >POR1 EQU  $8004  PORT 1
8008           >POR2 EQU  $8008  PORT 2
A00A           >PORA EQU  $A00A  ADDRESS OF PORT TO BE USED
A00C           >PORE EQU  $A00C  PORT ECHO FLAG
A61E           >CFMU EQU  $A61E  ENTRY FOR UTILITY TO LOAD CFM/3
E1D1           >OUCH EQU  $E1D1  CHARACTER OUTPUT SUBROUTINE
0000           >
0000           >*  PROGRAM PATCH:
0000           >
E28F           >     ORG  $E28F
E28F BD E3 34  >LOAD JSR  RDON    NEW ENTRY FOR 'L' COMMAND
E292 BD E0 0C  >     JSR  LOD1    LOAD DATA
E295 7E E2 D4  >     JMP  RDOF    TURN OFF RECORDER; JUMP TO CONTROL
E298 BD E3 34  >TAPE JSR  RDON    ENTRY FOR 'T' COMMAND
E29B CE 80 08  >     LDX  #POR2   SHIFT TO PORT 2 FOR 300 BAUD DATA
E29E FF A0 0A  >     STX  PORA
E2A1 BD E0 0C  >     JSR  LOD1    LOAD DATA
E2A4 CE 80 04  >     LDX  #POR1   SHIFT BACK TO PORT 1
E2A7 FF A0 0A  >     STX  PORA
E2AA 7F A0 0C  >     CLR  PORE    RESTORE ECHO FLAG
E2AD 7E A6 1E  >     JMP  CFMU    LOAD CFM/3 WITH HIGH SPEED INTERFACE
E2B0 CE 80 04  >ERRR LDX  #POR1   SHIFT BACK TO PORT 1
E2B3 FF A0 0A  >     STX  PORA
E2B6 7F A0 0C  >     CLR  PORE    RESTORE ECHO FLAG
E2B9 86 3F     >     LDAA #'?
E2BB BD E1 D1  >     JSR  OUCH    PRINT '?'
E2BE 7E E2 D4  >     JMP  RDOF    TURN OFF RECORDER; JUMP TO CONTROL
E2C1 01        >     NOP
E2C2           >
E2C2           >     END
*** UNRESOLVED:
*** SYMBOLS?
Y
CFMU A61E  ERRR E2B0  LOAD E28F  LOD1 E00C  OUCH E1D1
POR1 8004  POR2 8008  PORA A00A  PORE A00C  RDOF E2D4
RDON E334  TAPE E298
```

Listing 3.

```
LOCN B1 B2 B3
0000           >*********************************************
0000           >*  REMAINING CHANGES FOR INDIVIDUAL  *
0000           >*       SWTBUG MEMORY LOCATIONS          *
0000           >*********************************************
0000           >
0000           >*  DEFINITIONS:
0000           >
E298           >TAPE EQU  $E298   LOCATION OF TAPE BOOT ROUTINE
E2B0           >ERRR EQU  $E2B0   NEW LOCATION OF ERROR ROUTINE
E28F           >LOAD EQU  $E28F   NEW LOCATION OF LOAD ROUTINE
0000           >
0000           >*  CHANGES:
0000           >
E3E6           >     ORG  $E3E6
E3E6           >
E3E6 54        >     FCC  'T      NEW COMMAND 'T'
E3E7 E2 98     >     FDB  TAPE
E3E9           >
E3F3           >     ORG  $E3F3
E3F3           >
E3F3 E2 8F     >     FDB  LOAD
E3F5           >
E0FA           >     ORG  $E0FA
E0FA           >
E0FA E2 B0     >     FDB  ERRR
E0FC           >
E0FC           >     END
*** UNRESOLVED:
*** SYMBOLS?
Y
ERRR E2B0  LOAD E28F  TAPE E298
```

Listing 4.

SWTBUG monitor LOAD routine to an LOD1 subroutine. Also, the DISK boot had to be discarded to provide a TAPE boot plus modifications to retain the "L" LOAD operation, etc.

I had to change the SWTBUG monitor, which is on a 6830 ROM. After inspecting the SWTP 6800 circuitry surrounding the SWTBUG ROM, I noticed that the 2716 (or the 2758) EPROM was voltage compatible with the 6830, except for the chip select signal. Chip selection appeared possible with an additional NAND gate, so I drew up and implemented the design shown in Fig. 2.

I wired up a ribbon cable/24-pin header to a 24-pin socket for the 2716 and a 14-pin socket for a 7420 dual quad NAND gate. I embedded the program patches in Listings 2, 3 and 4 into the SWTBUG monitor and loaded the new monitor into a 2716. The total system worked!

I noticed a vector to the discarded code and had to change two more bytes. The system now provides for a "T" command to start the sequence briefly stated earlier. The TC-3 read utility is brought in through the 300 baud port 2. Upon completion of that load operation, the high-speed interface through port 4 is used to load the CFM file manager.

At this point, I made one additional modification. I added a few more bytes of code to the read utility to initialize the file manager and "RUN" load the TSC BASIC interpreter. Listing 5 shows all the modifications to the TC-3 read utility necessary to manage the operations.

Conclusion

By adding two home-workshop hardware modules to the SWTP 6800/2 and some software patches, I have created a much simplified load 'n go operation to get a high-speed BASIC interpreter operating. Total cost of the tape system was less than $200, including a stereo cassette deck that is occasionally pressed into service as an audio recorder.

I plan to drop a wire from the 2716 socket to a nearby tie-point on the 6800 CPU board to make the top half of the 2716 usable and thus acquire another K of PROM. It's tempting to consider using a 2732 and not have to load the file manager from tape. ■

```
LOCN B1 B2 B3
0000            >*********************************************
0000            >*    TC-3 UTILITY AS MODIFIED EARLIER       *
0000            >*   WITH FOLLOWING ADDITIONS AND CHANGE     *
0000            >*********************************************
0000            >
0000            >*  DEFINITIONS:
0000            >
AFFF            >CSTK EQU  $AFFF  CFM/3 CSTACK
A9F1            >REST EQU  $A9F1  CFM/3 RESET
A78B            >CFMS EQU  $A78B  CFM/3 RESTART
A048            >SWRS EQU  $A048  SWTBUG USER PROGRAM RESTART
AEC0            >BANR EQU  $AEC0  CFM/3 BANNER
E07E            >PDAT EQU  $E07E  SWTBUG PDATA1
A9D0            >INIT EQU  $A9D0  CFM/3 INITL
AF8D            >USTK EQU  $AF8D  CFM/3 USTACK
A82C            >CRUN EQU  $A82C  CFM/3 RUN
0000            >
0000            >*  ADDITIONS:
0000            >
A630            >     ORG  $A630
A630            >
A630 8E AF FF   >BASL LDS  #CSTK   STARTS CFM/3 AND JUMPS TO RUN
A633 0F         >     SEI          TO LOAD/RUN TSC BASIC
A634 BD A9 F1   >     JSR  REST
A637 CE A7 8B   >     LDX  #CFMS
A63A FF A0 48   >     STX  SWRS
A63D CE AE C0   >     LDX  #BANR
A640 BD E0 7E   >     JSR  PDAT
A643 BD A9 D0   >     JSR  INIT
A646 7F AF 8D   >     CLR  USTK
A649 8E AF FF   >     LDS  #CSTK
A64C BD A9 F1   >     JSR  REST
A64F 7E A8 2C   >     JMP  CRUN
A652            >
A652            >*  CHANGE:
A652            >
A5E4            >     ORG  $A5E4
A5E4            >
A5E4 7E A6 30   >     JMP  BASL
A5E7            >
A5E7            >     END
*** UNRESOLVED:
*** SYMBOLS?
'Y'
BANR AEC0  BASL A630  CFMS A78B  CRUN A82C  CSTK AFFF
INIT A9D0  PDAT E07E  REST A9F1  SWRS A048  USTK AF8D
```

Listing 5. Completely modified TC-3 utility.

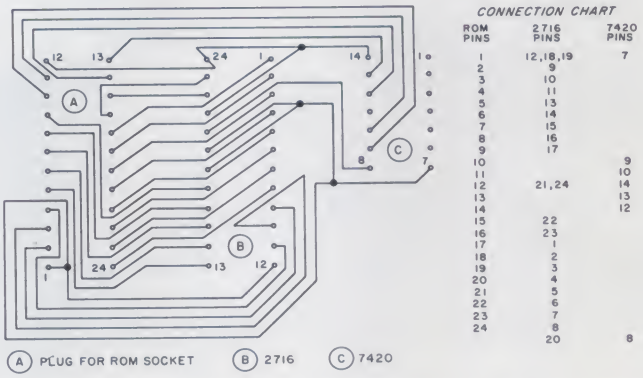


Fig. 2. ROM replacement module (viewed from the pin side of sockets).

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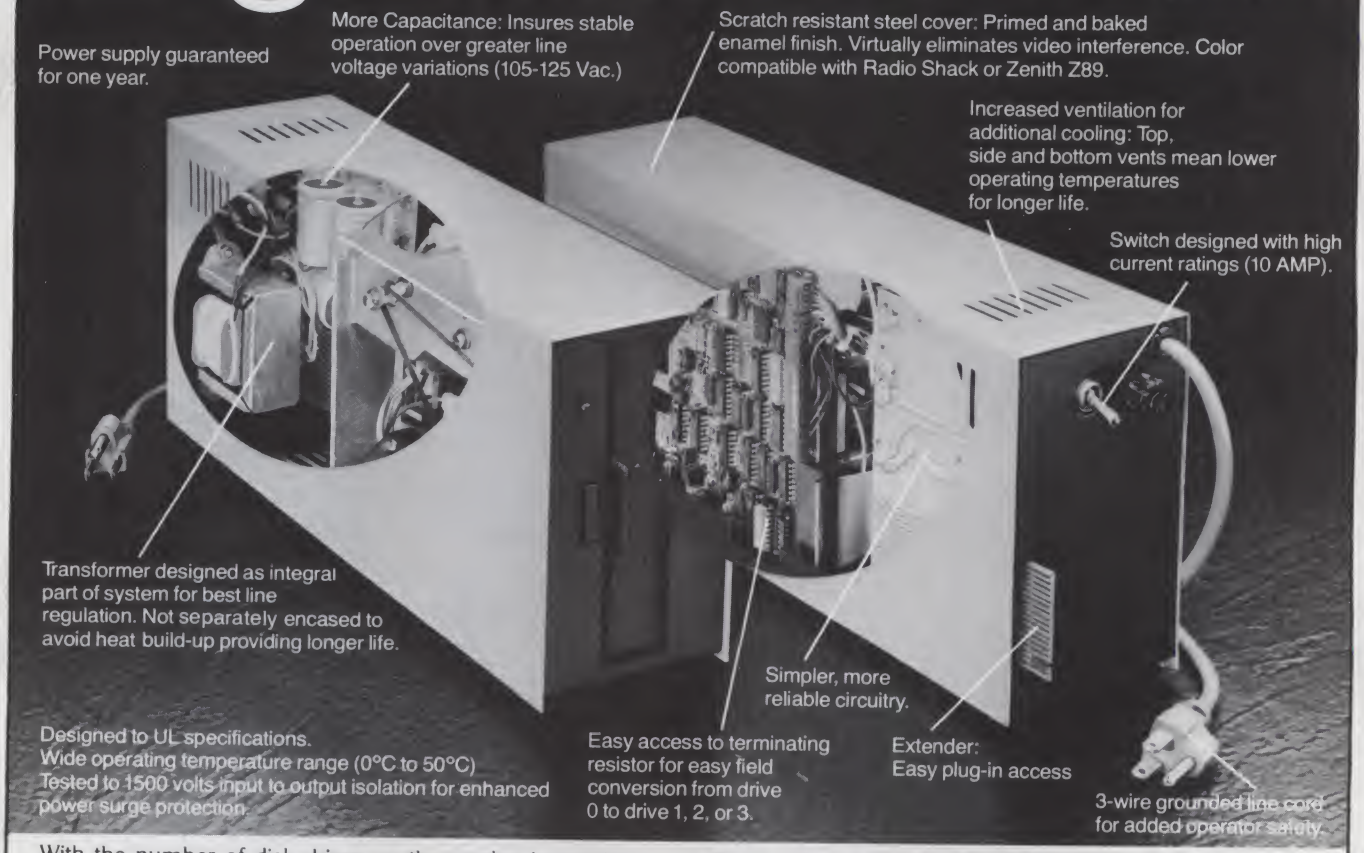
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Microcomputers in Education

Computer use in schools and its influence on education are increasing. With this thought in mind, *Microcomputing* presents this special supplement: "Microcomputers in Education." We think that students, teachers and parents will find it valuable and informative.—Editors.

Microcomputers in Education—This introductory article examines the use of computers in education today, and posits an educated guess as to their potential in American schools. Karen Billings. Page 100.

Bringing Microcomputers into Schools—Schools will need to know how to make microcomputing capacity available to students. In this article, two educators discuss how to obtain funding, list some sources of software and choices of equipment, and sketch some ideas on how to start a microcomputer curriculum. George Ropes, Henry Gaylord. Page 104.

Making the Grade at Keene High School—The microcomputing program at Keene (NH) High School is going strong. *Microcomputing* takes a look at Keene High's use of TRS-80s in the classroom. Dennis Brisson. Page 108.

Student Scheduling on a Small Computer—Before classes even start, avoid scheduling foul-ups with this 6800 program used by associate editor Pete Stark et al at Queensborough (NY) Community College. Peter A. Stark. Page 112.

Computer Survival Course for Kids—By the time most of today's young students reach college, they will already know programming fundamentals. The course described in this article was designed to expose junior-high-school students to computers. Everett Q. Carr, Claire J. Carr. Page 122.

Computerized Gradebook—Teachers, too, need exposure to computers—since they are inevitably going to use them in class. Teachers can use this program, "Scores," to keep students' grades. Charles Kaza. Page 126.

Math Teacher—Students can improve their grades with computerized practice exercises. This long-division program is suitable for use at home—where parents can learn about computers with their kids—or in school. Willis Cook. Page 134.

Physics Teacher—Specifically for use in school are these 11 programs, which give students a wide assortment of physics problems to solve. Two additional programs can help teachers figure grades. David O'Neil. Page 138.

Computer Education and Vocations—If students' grades are good enough, they graduate—but then what? This article explores post-high-school educational and vocational prospects. Peter A. Stark. Page 150.

Prospects for microcomputers in education look promising. So do prospects for publication of education-oriented articles in *Microcomputing*. *Microcomputing* encourages the submission of articles describing general or specific applications of microcomputers in education.

Microcomputers in Education: Now and in the Future

The picture's not all rosy, but this educator predicts a future for micros in school.

Karen Billings
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Teachers College
Columbia University
New York NY 10027

Although computers are indispensable to science, business and government, they have not realized their full potential in American education. In an information society, a computer-literate populace is important, and we may go through a crisis trying to develop it.

Just as the 70s became the decade of computer technology, the 80s must become the decade of computer education. For the past 15 years I've witnessed the tremendous growth of computer technology. However, until recently, I've seen relatively little interest among school personnel to provide student access to it. The marketing of personal computers, microprocessor-based games and word-processing machines has generated a recent surge of interest. Computers have become so prolific that the educators can't ignore them any longer.

Not only has the degree of interest changed but so has the kind of interest. For example, language-arts teachers are finding a new classroom tool. For some time they have used the computer in tutorial or drill and practice modes. Now the word-processing features and text-editors have made the computer a writing tool.

The Teacher's Viewpoint

What is exciting for one teacher is threatening to another. Although we can provide some teachers with the hardware, software and training, microcomputers may still not become a part of every classroom.

> Some teachers are philosophically opposed to computer use because of its 1984 image.

I understand why teachers 10 years ago weren't too excited about using mark-sense cards and transporting them to and from an IBM 360 at a nearby campus. Later, even with the more appropriate user languages and an extensive library of instructional programs, computers captured the interest of few teachers. Part of the problem was the justification of the cost and the inconvenience of time-sharing equipment. Furthermore, it was difficult to convince other colleagues that this was an instrument to be controlled, not feared.

Some teachers are philosophically opposed to computer use because of its 1984 image. Others refuse to get involved, sure that it's another fad that will die away like so many other curriculum innovations. Still others just don't want to bother, content to let the younger members of their staff take the responsibility.

Teachers do not think they will be replaced by a computer, but expect their role with students will change as they each learn to communicate with these machines. Could the microcomputer destroy traditional schooling altogether? Some people envision the gradual disappearance of books and the absence of schools as we know them. Teaching will be done at home on the computer with lots of drill and practice exercises.

While this scope of teaching may sound futuristic and threatening, I am convinced that software to change the classroom environment and provide a unique kind of motivation for students will eventually become available.

The Students

Teaching with a microcomputer has given me a chance to experience a potentially important resource in American education. I see the students excited by its

Karen Billings is director of the Microcomputer Resource Center at Teachers College, Columbia University. She has taught math and computer courses, and computer workshops and seminars. She is author, with David Moursund, of *Are You Computer Literate?*

interactivity, open-endedness and versatility in presenting text, sound and graphics. They are really being exposed to a "mind multiplier."

The students are much less afraid of the computers than are their teachers. They have more access and more time to get involved. Programming gives the student a chance to control the computer rather than being controlled. It emphasizes the process as well as the product. I can recall few other instances in school where a student describes an action, then executes it on command. Programming has enabled some of my students to share "intellectual products" with each other.

> To be usable tools, computers must be employed in a manner consistent with the teacher's philosophy and the school's curriculum.

Into the Classroom

Some educators want to see microcomputers fit into the existing school curriculum, while others want to see them change it. To be usable tools, they must be employed in a manner consistent with the philosophy of the teacher and the curriculum of the school. Most teachers will consider themselves liaisons between computer and student. They will not become hardware experts or programmers, but they will know enough to teach students how to use the equipment. Drill programs, tutorials, games and simulations can be written to fit into almost any curriculum. But teachers must determine the ratios of those different uses, the amount of "hands on" experience and the possibility of programming. To make these decisions, teachers will have to consider their individuals skills and interests, the atmosphere in the classroom and the philosophy of the school.

To use computers successfully, teachers must know what they want the machine to do in their classroom. They need information on the development of microcomputer use in schools and on available educational software to make their own decisions about equipment and software.

A recent report by *Conduit* (see box at right) revealed a variety of computer uses at the college level, including complex problem solving, simulations, model building and manipulation of large data bases. Drill and tutorial uses accounted for less than ten percent of computer use in instruction, although the percentage increases when interactive services are offered.

I suspect that the percentages are almost reversed for the elementary and secondary levels. Drill and practice, together with games, account for most of the computer time.

Two obvious reasons are the age or sophistication of the users and the nature of the equipment. Teachers are under pressure to emphasize skill building and to raise test scores. Drill and practice programs can create better-skilled students, and the public would love to see the trend of declining test scores reversed. The educators must use what is on the market or produce it themselves. Games are most available commercially, and drill and practice programs are considered the easiest to write.

Hardware, Software and Personnel Problems

The use of microcomputer technology is hindered currently by a relative nonexistence of appropriate instructional software. It's also hindered by lack of information about what people are doing in education. A clarification of its role at the elementary and secondary levels is needed.

People outside education think the problem lies with the staff, not with the hardware and software. They're not exactly impressed by the quality of thinking or practice in the area of education. If we educators want money for instructional computing when everyone in the schools is being asked to cut back, we will have to convince the public of its benefits. We will have to be able to show them what the computer can do better, and not just replicate in the learning process. It's going to be a tough challenge to make the computer an appealing tool so that taxpayers will buy it, and a lasting tool so the students will really gain from it.

Since I remain so optimistic about the potential of the microcomputer, I have to be realistic when it comes to solving some of the problems of using microcomputers in education. These solutions are not immediate, easy or inexpensive, but they are possible.

People are doing what they can. Teachers and parents are buying their own microcomputers; they are buying or producing their own software. They are taking courses, subscribing to computer journals and attending conferences to learn. Administrators are helping by budgeting for microcomputers and by searching for ways to train teachers in microcomputer use.

Some school districts are supporting teams of teachers and students to produce the needed software. Typically, a teacher who is knowledgeable about programming, available software and computer equipment organizes a team of programmers (usually high school programming students) and teachers with specific needs. The teachers discuss their objectives and the programmers write accordingly. The teachers critique and the programmers revise during the process, each time coming closer to the type of programs that teachers can use directly in their classrooms.

Some creative computer educators in the country have helped schools and computers to adapt to each other. Ludwig Braun, at the State University of New York, Stony Brook, is a leader in developing pre-college curricula. Tom Dwyer and Margot Critchfield, of the University of Pennsylvania at Pittsburgh, produce appropriate materials for computer users. Karl Zinn, of the University of Michigan, Ann Arbor, has instituted some *valuable projects*. Alfred Bork, University of California, Irvine, and Arthur Luehrmann, University of California, Berkeley, contribute to science education. David Moursund, University of Oregon, Eugene, and Robert Taylor, Teachers College, Columbia University, focus on teacher training at preservice and in-service levels. Joyce Hakansson, consultant to the Childrens Television Workshop in New York City, is coordinating the development of hardware and software for very young children. Patrick Suppes, of Stanford University, is responsible for many of the drill and practice materials on the market. Sylvia Charp, Philadelphia Public Schools, provides *critical insight* to the process of implementation. Bob Albrecht, People's Computer Company, and Seymour Papert, Massachusetts Institute of Technology, are strong advocates of children controlling the computers. The Elementary and Secondary Subcommittee of the Association for Computing Machinery, headed by Moursund, is busy this year gathering information nationwide about instructional applications. The Minnesota Education Computing Consortium (MECC), Lauderdale MN, serves as a model for leadership as a state organization. *Conduit* (University of Iowa, Iowa City) is an important resource for disseminating reliable software at the undergraduate level. *The Computing Teacher*, published by the growing International Council for Computers in Education (available through Eastern Oregon State College, La Grande OR), is the first journal that all educators should subscribe to. All of these people and many others too numerous to mention, openly share their ideas, and are also responsible for some major group efforts in instructional computing.

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The software currently on the market is largely the result of hundreds of different people, all writing independently of each other, for different microcomputers. The level of their programming skill varies as do their standards for their programs. Given the technical problems with using cassette tapes, we risk buying a program that's of questionable quality or one that won't load on our machine.

Some major, organized efforts to produce educational materials for use with microcomputers exist. Publishers who do this are taking risks when they enter this unpredictable market. (Can you imagine trying to do cost projections, or finding the right person to head the effort?)

Questions for Educators

Should a school buy one complete system (with printer, disk and memory expansion) that provides more capabilities and applications or several microcomputers that provide more hands-on experiences for students?

Selection of this hardware poses philosophical questions for educators. Should we select one all-purpose machine that does limited drill and practice and that has limited programming potential? Should we, instead, select a dedicated computer that has excellent drill and practice programs, and a different machine on which students can learn to program? Should the computer be in control of the student or should the student be in full control of the computer? Is there a machine that serves both student and teacher needs in the classroom? What computer can carry out both administrative and instructional functions and is it better than buying two separate pieces of hardware?

Tentative Solutions

Only when we can tell equipment manufacturers what we want the computer to do and when we can afford to pay for it, will we have the appropriate hardware. If and when we can show software houses and publishers that we will support their educational programs, we'll get the desired instructional software. As long as small businesses are purchasing more microcomputers than schools, the hardware manufacturers and software developers will direct their efforts in that direction.

It is exciting to look at the potential of the microcomputer in the classroom. It is frustrating to list all the things that must be done, but also rewarding to see the progress. The problems involved with putting microcomputers to their full use in the classrooms have complex and costly solutions, but I am confident that education will solve these problems as soon as its humanly and technologically possible. ■

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Bringing Microcomputers Into Schools

How to get funding and where to look for software, what equipment to buy, how to start a microcomputer curriculum? These are some of the questions addressed in this article.

George Ropes
Henry Gaylord
Box 533
Goldens Bridge NY 10526

Schools are on the threshold of the microcomputer age. Not only high schools, but also junior highs and elementary schools can share in the many benefits microcomputers bring to education. Educators are asking what they can do, what they should do, to make microcomputing capacity available to their students. This article provides the information and procedures educators need to leave "ground zero" and join the ranks of those who have already found how much a few microcomputers, or even a single micro, mean to a school.

Objectives

Those who have worked with microcomputers are strongly of the opinion that no other single piece of equipment can do as much for education. The nearly unanimous conclusion is that micros motivate students to a remarkable extent.

They are unexcelled at teaching logical thinking. They provide frequent opportunities for students to demonstrate their creativity. They are valuable in all curricular areas, not just in mathematics. They provide effective, individualized review and practice, with immediate feedback on performance. Learning about microcomputers and how to use them may be the most valuable part of a student's schooling.

A school contemplating a microcomputer program should set its sights on accomplishing at least one of the following goals:

Increasing students' computer literacy
Teaching students to write programs
Providing opportunities for learning through simulations and games
Teaching subject matter, such as mathematics, science, social studies
Building skills in vocabulary, spelling, computation, shape recognition
Drill and practice on basics

The broader the scope and objectives you have in mind, the more thorough the preparations and training should be. Once you have an idea of the direction to take, two considerations have priority: sources of funds and choice of microcomputer.

Obtaining Funding

Schools have found a number of different answers to the problem of funding. Some boards of education have put money for microcomputers into their budgets. Some school districts have applied for and obtained federal grants under Title IV-C sections authorizing funds for career training or for gifted and talented students. Others have convinced the local Parent-Teacher Association to appropriate money for one or more microcomputers. When the cost-effectiveness of a microcomputer is compared to that of a color television, videotape equipment or even to a district's service vehicles, funding problems are seen in better perspective.

Choice of Equipment

Deciding on which microcomputer or microcomputers to purchase is important, but not necessarily critical. There are differences between micros as there are between automobiles, but with each of the popular makes you can expect years of dependable service.

You shouldn't put off purchasing a micro in the hope that a sharp price decrease is just around the corner. Few people believe that microcomputer prices will come down the way calculator prices fell over the last few years. You can expect the next round of microcomputer models to have greater capabilities at or near current prices. If you want your students to start getting to know and use micros, the time to begin is now!

For most schools, we feel that decisions on equipment should favor the solution that accommodates the largest number of students. The experience of sitting down at the keyboard and operating the microcomputer is crucial to learning.

We recommend that you have at least 8K (approximately 8000 characters) of addressable memory. You will do well to have a relatively full version of BASIC, the language used by virtually every microcomputer. Your micro should be able to handle decimal numbers, not just integers. Choose color capability if programs involving designs and patterns are important to you.

Current (April 1980) prices for the three best-selling models are approximately as follows:

$850—Radio Shack TRS-80 Level II 16K. (The TRS-80 Level I 4K costs $499. If this is the only one you can afford, plan to spend $250 to $350 to upgrade it to Level II.)
$530—Commodore PET 8K. (Based on cur-

Henry Gaylord is assistant head, Cisqua School, Bedford NY. He has taught computer programming throughout the school, for Mercy College and for the Chappaqua Adult School.

George Ropes is consultant on math for the gifted, Putnam/Northern Westchester B.O.C.E.S., adjunct professor at Fairleigh Dickinson University, Teaneck NJ, and elementary math coordinator, Edgemont School District, Scarsdale NY.

rent 3-for-2 offer to schools. No tape recorder included.)
$1195—Apple II with Integer BASIC or Applesoft BASIC 16K. (No tape recorder or monitor included.)

Check out the micros available at nearby outlets. Check on the experience of other schools in your vicinity. A knowledgeable and interested person at a local store can be a valuable aid to your microcomputing program.

Learning the Language

After considering funding and the microcomputer model, you should examine how to use the microcomputer(s) in your school. At least one person should be familiar with the BASIC language, which consists of about 30 words, a dozen symbols, two dozen functions, punctuation marks and a few rules for writing statements.

Mastery of BASIC takes lots of time and practice. However, the ability to write a simple program in BASIC or to understand uncomplicated programs written by others can be acquired relatively quickly. Knowledge of BASIC is valuable for introducing the language to students and making minor modifications in commercially available programs. It is often useful to change a program so it is easier or more difficult or more appropriate for a given student or group of students.

If someone in your school already knows BASIC, you're well on your way to microcomputer capability. However, there are minor differences between BASIC as implemented on time-sharing terminals and the BASIC of microcomputers, as well as between the versions of BASIC on various makes of microcomputers.

Start-up and editing procedures differ slightly also. Some functions are called by different names: the ENTER key on one machine might be RETURN on another. Generally, a little practice and a few references to the manual are all it takes to smooth the transition.

To learn BASIC from scratch is not a mountainous undertaking. First, you must obtain a good manual. The best manual on the market is *BASIC Computer Language* by David A. Lien. It is published by Radio Shack and applies specifically to the version of BASIC used on the TRS-80 Level I. This version of BASIC does not include some of the commands and statements found in the Level II version of BASIC. However, in a separate volume, *Learning Level II* (Compusoft Publishing), the author provides all the changes—line by line and page by page—to convert the earlier manual into one that teaches you Level II BASIC on the TRS-80.

If you are using a PET microcomputer, get *Hands on BASIC with a PET* by Herbert D. Peckham, McGraw-Hill. For those using BASIC on an Apple II computer, the manufacturer's *Apple BASIC Programming Manual* is the answer.

But whatever microcomputer you have and whatever manual you use, best results come from sitting down at the computer and working through the material page by page. Just as in most other learning experiences, you learn fastest and best by doing. This is not to denigrate courses that teach computer programming.

We have taught hundreds of students of all ages and have found that the greatest amount of learning takes place when a student practices what he learns on the computer in the days between class meetings. Fortunately for teachers, microcomputers are portable. They can be easily transported from classroom to classroom or taken home.

Does every teacher at a school need to know BASIC? Certainly not. The more who do learn BASIC, the better, but microcomputer use can be extensive in classrooms where teachers know nothing of the language.

Every teacher must know how to operate the microcomputer and how to load programs into it from cassette tapes. Incidentally, the teacher need never fear that microcomputers will eventually "take over" the classroom. Actually, the more computers, the more important the teacher becomes.

Programs on Cassettes

You can connect each microcomputer to a standard cassette player, which is used to provide long-term storage of programs. The process of entering programs via the cassette player is comparable in difficulty to running a film projector. After a few minutes' instruction and an hour's practice, the task becomes routine. It involves positioning the tape to the start of a particular program, typing a "load" command on the keyboard, playing the cassette and waiting until the computer indicates that loading is finished.

Programs on cassette tapes are referred to as "software." The amount of software available for use in schools is growing; new tapes are coming on the market every month. Unfortunately, program quality varies; some tapes contain programs that are excellent; some are fair; some poor. It is not easy to get responsible opinions about software in advance of purchase.

Among the types of educational programs available are:
Demonstrations of math processes
IQ building with synonyms, antonyms
Work with foreign languages
Spelling, vocabulary
Games requiring logical thinking
Simulations
Recognition of shapes, letters
Arithmetic drill and practice
Graphic designs

From time to time, this magazine and others in the field publish programs that can be used or adapted for use in schools. It pays to keep abreast of developments by subscribing to two or three of the leading periodicals. The computer departments of a few universities have started to make available information about educational programs at all levels, as have education departments in a few states.

Creative Computing, Box 789-M, Morristown NJ 07960.
Hayden Book Co., 50 Essex St., Rochelle Park NJ 07662.
Instant Software, Inc., Peterborough NH 03458
Micro Learningware, Box 2134, Mankato MN 56001.
Minnesota Educational Computing Consortium, 2520 Broadway Dr., Lauderdale MN 55113.
National Coordinating Center for Curriculum Development, State University at Stony Brook, Stony Brook NY 11794.
Program Design, Inc., 11 Idar Court, Greenwich CT 06830.
Programma International, Inc., 3400 Wilshire Blvd., Los Angeles CA 90010.
The Program Store, 4200 Wisconsin Ave., N.W., Washington DC 20016.
Queue, 5 Chapel Hill Dr., Fairfield CT 06432.
Radio Shack (contact nearest store).
Software Exchange, 6 South Street, Milford NH 03055.

Table 1. Sources of cassette tapes in the educational field.

Table 1 lists companies and organizations that distribute educational software. The listing is representative only; it does not purport to include every company that offers programs you might use.

Be sure any programs you order are for your particular microcomputer. Programs are not interchangeable between makes of computers. A TRS-80 Level I program cannot be used on Level II. Similarly, programs for Apple II with Integer BASIC don't work on Apple II with Applesoft BASIC.

The demand for educationally based microcomputer programs is such that new programs originated at your school may be useful to many other school systems. Someone on your staff—or among your students—may develop better programs than

some of those that exist today.

Utilization

Given a school with one or more microcomputers, given one or more teachers who know BASIC and given a set of good programs, what is the best way to deploy these resources? How is capability transferred into day-to-day operation? There are several possible procedures.

Microcomputers may be placed in a given location where classes can be scheduled for specific computer programming lessons. Individuals can come to that location for specified periods of time, usually on a "sign up in advance" basis.

Must someone be present at all times to supervise students? Some schools have made arrangements for such supervision, but many have found it unnecessary. Microcomputers are relatively foolproof. Provided no more than two students are assigned to one micro at one time, experience has shown that they work well by themselves.

Another common procedure is to use an audiovisual cart to move a microcomputer from room to room on a scheduled basis. This allows the teacher to use the computer to demonstrate a given lesson or to assign students 10 or 15 minutes each on the computer. Different students can work with different programs. Students, even as young as second-graders, quickly learn how to insert and run tapes.

A network controller for the TRS-80 directs the loading of programs into as many as 16 microcomputers in a single classroom. Such a setup permits working with a class as a unit and also lets each class member interact individually.

Junior high and elementary schools have found it advantageous to have a knowledgeable high school student work with their students. The high school student can teach BASIC or act as a resource person for a "computer club." Parents with some background in computing can be of assistance at all levels. Information on special programs or counsel on long-range objectives may often be obtained from a consultant in the field.

The Future

Each school needs to work out the procedure or combination of procedures for microcomputer implementation that best suits its particular needs. Whatever the needs are today, it is safe to predict that they will be different and greater tomorrow. The numbers of students who are turned on by microcomputing will convince you to get more micros and expand your program until the majority of students acquire the computer capability that will virtually be a sine qua non for life in the 21st century. ■

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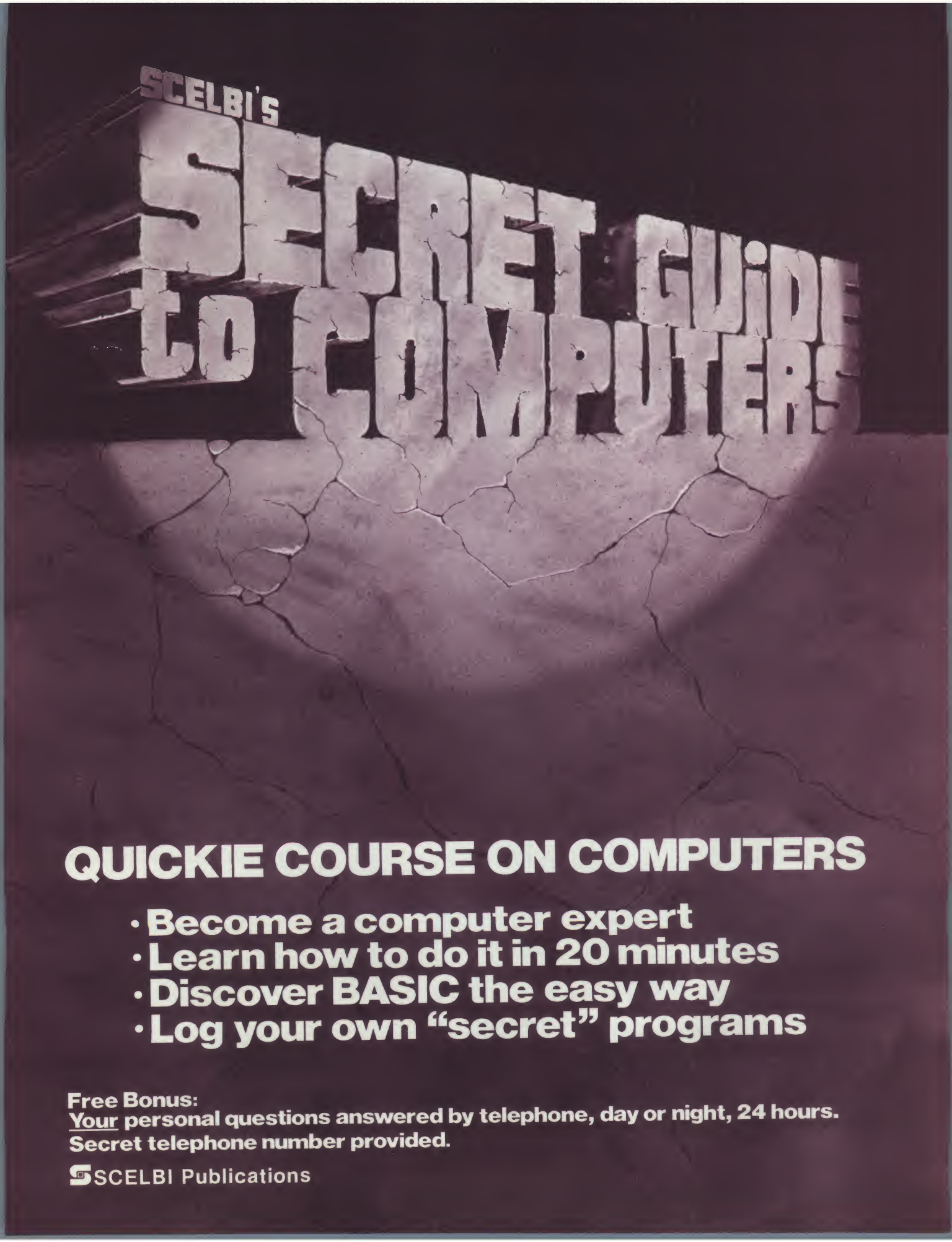
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Making the Grade At Keene High School

From a time-sharing terminal to calculators to a minicomputer, and then to microcomputers, this school put various computers to the test. The TRS-80 passed with high marks.

Dennis Brisson
Microcomputing *Staff*

Keene (NH) High School increased its enrollment last fall by 13. That's the number of TRS-80 microcomputers the school brought into the classroom for its computer-programming classes. Although the use of desk-top computers for individualized instruction is in its infancy at the school, computer use and instruction is not a new idea. Indeed, Keene High was one of the first public schools in New Hampshire to make use of computers.

If KHS can be credited with breaking new ground in the computer-education field, then its principal trailblazer is Charles Tousley, math department head, who has taught programming at the school for the last 13 years. During that time, he has seen the school experiment with various computers. It was his pioneer spirit that recently prompted KHS to board the microcomputers-in-education bandwagon.

Tousley was well tutored in the fundamentals of computer programming. He notes with some pride, "I learned BASIC from the man who invented the language, Dr. John Kemeny." As part of a contingent of representatives from Vermont and New Hampshire public schools, Tousley studied the time-sharing system at Dartmouth College under the direction of Kemeny in 1967. Having learned the intricacies of programming, he operated the high school's time-sharing terminal, which hooked into the Dartmouth system. But this arrangement for teaching programming was expensive. "It cost $6000 a year just to rent the equipment," explains Tousley.

In 1972, Keene High discontinued this system and purchased programmable 8-bit calculators for its computer classes. In 1976, the students learned programming on a PDP-11 minicomputer, which the Cheshire Vocational Center, adjoining the high school building, purchased.

Advances in the computer industry produced other, less expensive, alternatives. The microcomputer had arrived, making individual use by students a practical means of teaching programming. Tousley's eyes brighten as he recalls, "Two years later, along came the TRS-80."



Under the watchful eye of programming instructor Tousley, students are learning the basics of programming.

Problem of Funding

Early on, Tousley recognized the value of microcomputers in education as effective in increasing student achievement and in motivating students. However, finding people who shared his enthusiasm proved difficult at first. One such person who shares his vision of future school uses of micros is John Amstein, head of the science department at the school, and instrumental, together with Tousley, in setting up the school's microcomputing program.

Whereas Tousley learned BASIC just two years after its development, Amstein is a self-taught programmer and a relative newcomer to computers. Despite these divergent backgrounds, the two are working together toward a common goal: establishing microcomputer use at the school for all subjects. Tousley explains: "John, who hadn't done any work with computers at all until this year, at least has the enthusiasm I've got; he recognizes the importance of them." He adds, "We are always dumbfounded when we can't find the same enthusiasm in the people who control the drawstrings on the purses."

Obtaining funds for innovations in education, particularly microcomputers, is difficult at best, as Tousley, who follows closely the latest developments in computer education and the problems of other schools, is well aware. With school boards and administrators grappling with the rising costs of running a school, they are reluctant to defend the initial investment for computer equipment. They question, too, the cost-effectiveness of microcomputers as compared to the more traditional teaching aids.

Tousley sees this thread of thinking running throughout the nation. "We all run into the same problem: administrators and school-board members went to school when there weren't any computers. So trying to convince them that computers are a necessity in the curriculum is a heck of a hard job," he laments.

Tousley feels that the schools' money couldn't be more wisely spent. On this point, he is as persuasive as he is determined. Approaching the school board for the OK on this year's microcomputer expenditure, Tousley was armed with a convincing statistic he derived while thumbing through the help-wanted ads in a Boston Sunday paper: over 75 percent of the employment opportunities required some knowledge of computers or a related math background.

The previous year, the school board approved the purchase of two TRS-80s, which "proved so satisfactory in the classroom that we went to the board again the following year to ask for more money."

He got the money—not the $10,000 he requested from the school board, but $9000 the board allocated from a special school source, the Academy Fund. This year he's going after more money to purchase more computer equipment. He's seeking $4000 from the Academy Fund and a federal government Title IV three-year grant for $40,000. He modestly explains his success: "Basically, I recognized the importance of computers and their place in school, and I just kept after people until we got the money to get them [the microcomputers] into the classroom."



TRS-80 desk-top design constructed by Tousley with ample space for monitor, keyboard, load/save modification and cassette recorder.

Educators' Reactions

Getting computers into the classroom is one thing; convincing others of their teaching potential is another. Tousley has been instrumental in encouraging and aiding area schools to establish microcomputer programs. But he has encountered obstacles. He has run up against educators who are reluctant to accept computers, to experiment and explore the potential of computers as a teaching tool. He cites administrators who dislike the prospect of curriculum changes involving computers because "it means changing all the methods they've developed over the years."

Even more myopic are math teachers "who are serious when they can't even think of any uses for computers. They can't imagine why computers are anything other than toys," Tousley says in disbelief.

Through the education of the people involved, the trend is changing, according to Tousley. "We're fighting a constant battle with people who are entrenched in the old way of doing things. Hopefully, this will gradually change. I know it will," he adds optimistically.

Today's students, born in the computer era, will reap the benefits of an advanced technology that has resulted in computer-assisted instruction. But today's teachers in the high schools, and even in the grade schools, face a challenge: how to deal with the influx of microcomputers in the classroom.

At Keene High, Tousley sees a positive reaction among the teachers. He is quick to point out that the Keene High administration has been supportive of the microcomputing program, and inquisitive teachers have borrowed the TRS-80 manuals and units ("admirably suited for self-learning") to learn programming at home in order to better understand the educational value of these machines.

Next year he plans to initiate workshops for the teachers about computers and their potential for classroom teaching. His enthusiasm for, and belief in, computers is catching . . . particularly among his students.

Uses in the Classroom

Tousley's students need no supervision, nor anyone to tell them to begin class. Computer programs allow the students to practice and learn on their own, with immediate feedback on their progress. When not in use by the programming classes, the micros are in operation by the students during their free periods.

The purchase this year of the 13 Level II 16K TRS-80s was a joint project of the school's math and science departments. As presented by Tousley and Amstein to the administration, the microcomputing pro-

gram involves three phases.

The first phase seeks student involvement—to familiarize the students with the fundamentals of programming and introduce them to all the capabilities of the microcomputers. Tousley has found that the best way to introduce students to computers is through hands-on experience. He concentrates on the graphics capabilities of the computers and relies heavily on computer games to spark student interest.

Game playing is a fundamental first step in learning the use of computers. But for most students, the game-playing stage lasts briefly before they realize the potential for more constructive uses and become eager to write their own applications. The school even boasts its own computerized radio station where the DJs can call up information on the latest Top 40 hits or recording star on the station's TRS-80.

"The first year of the project, we're trying to get as many people acquainted with the computer as possible. We want to mass-produce enthusiastic students," says Tousley.

As students use the computers more and as teachers become more involved, Tousley and Amstein predict that ideas for applications in the classroom will blossom. Outside of the programming classes, the computers see limited use in computer-aided instruction (CAI). The school uses some CAI programs to drill students on the concepts of algebra and basic math. CAI programs are also used in science: genetic cross-breeding, population growth and diet-calorie analysis programs for biology. A student who was in Tousley's computer-programming course last year and is a physics student in Amstein's class this year converted a sun-tracking program into TRS-80 BASIC.

Tousley's programming classes include about 32 sophomores and juniors. As seniors, with the knowledge of BASIC programming, they will be expected to write their own applications in the physics and science classes, an idea particularly appealing to Amstein, who ranks the computer as valuable a tool as the microscope to teach science.

Phase two of the microcomputing program involves creating applications programs and expanding the school's collection of science and math program tapes. Teachers would probably prefer plug-in software, but the KHS program calls for the students to write their own, thus expanding the learning process involving computers.

Although the amount of software on the market is growing, Tousley and Amstein cite the general lack of educational programs. They realize that computers as educational tools are only as effective as the programs written for them. So they plan to develop their own; the students will write their own applications for use in advanced math, geometry, calculus, physics, chemistry and biology. Compiling a library of good program tapes will take time.

In the third phase, Tousley and Amstein want to see the widespread use of computers throughout the school in all subjects. As Amstein explains, the school's immediate future goals include equipping a complete computer classroom, installing a computer in each of the school's 18 classrooms and making computers available to students in the library during their free time.

"By the third year of the program, we should have a large supply of program applications. We want people to realize that computers are not just tools for math and science, but for English, foreign languages and who knows what else," explains Tousley.



KHS students take their programming seriously, and are constantly coming up with program applications and school-related uses for the computers.

Choosing the TRS-80

After investigating the various microcomputers on the market, KHS opted for the TRS-80 over the PET ("tiny keyboard design was a major mistake") and the Apple ("twice the price"). From the outset, Tousley was convinced that the TRS-80 was the computer for the job at KHS. "I can't see how anyone is going to compete against the TRS-80. It's the best one for the job. It isn't the best computer in the world, but for its price, and for what we want to do with it in school, there's no other competing model."

Quality and low cost were the two main features of the TRS-80 that prompted the school's selection. The availability of nearby service and the maintenance support offered by a local Radio Shack store also appealed to the school, as did the unit's portability, which allows it to be transported from classroom to classroom. The trigonometric-functions capability was also attractive.

Next year the school plans to buy several more TRS-80s, line printers and the Radio Shack Network System, which allows up to 16 microcomputers to use the same disk drive. The classroom setup at present features a large, modified TV-screen monitor from which Tousley can instruct the entire class. Each computer is comfortably situated on its separate desk-top area, with a place for keyboard, cassette recorder and monitor, as well as a CLOAD and CSAVE switch modification constructed by Tousley.

Class Dismissed

Many educators, such as Tousley and Amstein, believe that computers are destined to have a profound influence on the way we educate our children. More educators are investigating the impact of computers on the education process—not just as tools for teaching, but to prepare the students for post-high-school education and for a world increasingly influenced by and dependent on the use of computers. Their place in the classrooms at Keene High has been assured by the enthusiastic reception by students and faculty.

After a brief period at the computers, the students are anxious to begin computer applications programs. Quiz and data programs, storage for foreign-language vocabulary and other data-storage uses are several applications the students are working with.

While no student has yet developed a program to replace the teacher in the classroom, the day is fast approaching when a computer in every classroom will become a reality.■

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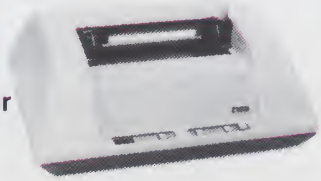
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Student Scheduling On a Small Computer

This college used a 6800 system to keep track of student scheduling.

Peter A. Stark
PO Box 209
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About eight years ago, our college (Queensborough Community, in Bayside NY) decided to change its old-fashioned registration procedure to a modern, fully computerized one. Over the years, we spent several million dollars to equip and staff a modern administrative computer center. We installed a computer with over a million bytes of memory and over a dozen disk and tape drives. This computer also had on-line terminals and "point-of-sale" terminals. In spite of this substantial investment, we still go through the same old registration procedure three times a year.

A few months ago, several professors who own relatively modest personal computers decided to see whether we could use our computers to do some of the work that the big, fancy college computer couldn't seem to do. This scheduling program is one result of that experiment.

College Registration

Registration is the procedure where our students sign up for the courses they are going to take each term. At our school, before a term begins, each department prepares a list of courses and their time slots during the week to be offered the following term. The compiled list of sections and courses to be offered is distributed to students. During registration week, each student tries to pick those sections that give him the best class program for each week. As a result, some sections may fill up early, while other, less popular, sections may remain almost empty and eventually be cancelled.

This old-fashioned process is called arena-style registration. I went through it back when I went to college (in pre-computer days), and it was probably popular in my grandfather's time, too.

Many colleges have better ways, ranging from arena-style registration with some computer assistance to fully computerized methods and mail-order registration. Our personal computers obviously couldn't compete with that, so we didn't even try.

However, microcomputers can handle smaller jobs quite well, such as preparing a program for each student from among the courses and sections being offered, checking it for errors and conflicts and keeping a tally of which student is signed up for each course. Our computer system does the first two phases of this registration task, and will soon be extended to handle the third phase. Formerly, faculty members handled

```
SELECT -
  SAVEFILE   - SAVE COURSE FILE BACK ON DISK
  OPEN XXX   - OPEN COURSE XXX
  CLOSE XXX  - CLOSE COURSE XXX
  PRINT      - PRINT CURRENT SCHEDULE
  NEW        - ERASE CURRENT SCHEDULE
  TRY XXX    - TRY COURSE XXX FOR CONFLICT
  TAKE XXX   - TAKE COURSE XXX
  REMOVE XXX - REMOVE COURSE XXX FROM SCHEDULE
  FIND XXX   - FIND COURSE XXX WHICH FITS
  ADDFILE    - ADD COURSE TO COURSE FILE
  FEED         PAPER FORM FEED
COMMAND ? NEW
ENTER STUDENT NAME? JOHN SMITH
COMMAND ? TAKE DS114C
COMMAND ? TAKE PS201A
COMMAND ? FIND CA11
PRINT CONFLICTING COURSES? NO
CA11A IS O.K.
CA11B IS O.K.
CA11/W IS O.K.
COMMAND ? TAKE CA11A
COMMAND ? FIND CA11/
PRINT CONFLICTING COURSES? YES
CA11/W - NO CONFLICT
CA11/ML -    CONFLICT WITH DS114C ON MONDAY AT  3  O'CLOCK.
COMMAND ? TAKE CA11/W
COMMAND ? PRINT


        COMPUTERIZED REGISTRATION - E. T. DEPARTMENT


JOHN SMITH

HOUR       MONDAY     TUESDAY    WEDNESDAY  THURSDAY   FRIDAY

 8 AM                             CA11/W
 9 AM                             CA11/W
 10 AM                            CA11/W
 11 AM     CA11A                  CA11A                 CA11A
 12 NOON              PS201A                  PS201A
 1 PM
 2 PM                             PS201A
 3 PM      DS114C                 DS114C     DS114C     DS114C
 4 PM


COMMAND ? TRY CA11/ML
   CONFLICT WITH DS114C ON MONDAY AT  3  O'CLOCK.
COMMAND ?
```

Sample run.

```
0100 REM P. STARK VERSION 3-28-80
0110 REM THIS PROGRAM READS THE "COURSES.TXT" FILE
0120 REM AND CONVERTS INTO "COURSES.FIL" FILE
0130 REM CN$=COURSE NAME, CT=TITLE, CL=COURSE NO LIMIT

0140 DIM CN$(200),CT(200,6) : CL=200

0150 REM READ COURSES.TXT FILE INTO ARRAYS

0160 OPEN OLD "COURSES.TXT" AS 1
0170 GOSUB 310
0180 CLOSE 1

0190 REM NOW WRITE ARRAYS INTO COURSES.FIL FILE

0200 OPEN NEW "COURSES.FIL" AS 2
0210 FOR I=1 TO NC
0220     PRINT #2, CN$(I);CHR$(13);
0230     FOR J=1 TO 6
0240         PRINT #2,CT(I,J);CHR$(13);
0250     NEXT J
0260 NEXT I
0270 PRINT #2, "END-OF-FILE"
0280 CLOSE 2
0290 PRINT "FILE CONVERTED."
0300 END

0310 REM ROUTINE TO READ "COURSES" FILE INTO ARRAYS -
0320 REM CN$ IS NAME, CT ARE COURSE-TIMES

0330 ON ERROR GOTO 690
0340 FOR I=1 TO CL
0350     INPUT LINE #1, A$                          :REM READ LINE FOR 1 COURSE
0360     PRINT A$
0370     FOR K=1 TO LEN(A$)
0380         IF MID$(A$,K,1)="," THEN GOTO 410      :REM FOUND COMMA
0390     NEXT K
0400     PRINT "NO COMMA IN "; A$ : STOP
0410     CN$(I)=LEFT$(A$,K-1)                       :REM SAVE COURSE TITLE
0420     PRINT CN$(I)                               :REM PRINT OUT COURSE NAME
0430     NC=I                                       :REM SAVE NUMBER OF COURSES

0440     REM NOW GET COURSE TIMES, CONVERT, STORE

0450     FOR J=1 TO 6
0460         FOR L=K+1 TO LEN(A$)
0470             IF MID$(A$,L,1)="," GOTO 540       :REM FOUND COMMA
0480         NEXT L
0490         IF L=LEN(A$) THEN L=L+1 : GOTO 540     :REM EOL
0500         CT(I,J)=0                              :REM END OF TIME DATA
0510         PRINT I,J,CT(I,J)
0520         GOTO 660

0530         REM TIME CODE IS FROM K+1 TO L-1

0540         B$=MID$(A$,K+1,1)
0550         T=0
0560         IF B$="M" THEN T=100
0570         IF B$="T" THEN T=200
0580         IF B$="W" THEN T=300
0590         IF B$="V" THEN T=400
0600         IF B$="F" THEN T=500
0610         B$=MID$(A$,K+2,L-K-2)                  :REM TIME
0620         CT(I,J)=T+VAL(B$)                      :REM CODE FOR DAY AND TIME
0630         PRINT I,J,CT(I,J)
0640         K=L
0650     NEXT J
0660 NEXT I
0670 PRINT "MAXIMUM OF "; CL; " COURSES REACHED."
0680 RETURN
0690 IF ERL=350 GOTO 720
0700 PRINT "ERROR ";ERR;" IN LINE ";ERL
0710 STOP
0720 IF ERR<>8 GOTO 700
0730 RETURN
```

Listing 1. Course File Conversion program in TSC BASIC.

the entire chore.

The Programs

This article describes two programs: The first one is only used to convert a manually prepared text file into one more usable by the second program, which actually does all the work. Both of these programs are written in BASIC, and our versions use TSC BASIC and run on a 40K SWTP 6800 computer using the Flex disk operating system.

Although this program uses a disk for file storage, you could modify it for cassette (one professor has modified it to run on his tape TRS-80). In any case, the BASIC may be adapted to almost any other computer.

Course File Conversion Program

In order to do student scheduling, the computer must first receive a complete list of all sections being offered and their times. We don't enter all the courses in the entire school . . . only those courses offered by our department (the Electrical and Computer Technology department), as well as related math and physics courses that are required of our students. The programs are set up for 200 different sections.

Courses are identified by two letters and two or three numbers, such as MA41 or PH202. The two letters specify the department, such as MAth or PHysics, while the numbers identify the particular course (for example, MA41 might be calculus 1, while MA42 is calculus 2). The course number is then followed by an additional code, such as A, H1 or /WL, that identifies a particular section.

A course might meet from one to six hours per week, and each meeting is entered as a letter for the day (we use V for Thursday to differentiate it from T for Tuesday), followed by one or two digits for the hour. This information is entered into a disk file called COURSES.TXT by using the standard text editor supplied with the SWTP disk system. The resulting file may look like this:

ET11B, M11, W11, F11
ET11/ML, M2, M3, M4

In this example, ET11, section B, meets Monday, Wednesday and Friday at 11 AM, while ET11/ML (a three-hour lab) meets Monday from 2 to 5 (listed as 2, 3 and 4 o'clock).

This entry format is easy to use but requires some computer processing to allow immediate use. Rather than put these processing steps into the main program (and use up precious memory space), the conversion into a more usable form is done separately in this program and the result written into a new disk file called COURSES.FIL. For the above data, this file is:

```
ET11B
111
311
511
0
0
0
ET11/ML
102
103
104
0
0
0
```

END-OF-FILE

The data for each course consists of seven lines: the first line gives the course and section code, while the following six lines contain coded day and hour information for up to six class meetings. Monday hours start with 100, Tuesday starts with 200 and so on, while the last two digits include the hour. If a class meets fewer than six times a week, the remaining hours are coded as 0. The last line of the file contains the words END-OF-FILE.

The Course File Conversion program (Listing 1) can handle up to 200 sections (CL is set to this limit), and the 200 course and section codes are stored in a string array dimensioned as CN$(200). Array CT$(200,6) accommodates the six possible class meetings for each section.

The subroutine in lines 310 through 680 reads the original text file into these arrays, while lines 200 through 300 write the results back into the COURSES.FIL disk file.

Unique Statements

Lines 160 and 200 specify the input and output files for the program. The "old" file is used for input and is identified as file 1 throughout the rest of the program, while the output file is identified as file 2, as in line 220, which asks for CN$(I) to be output to file number 2, followed by CHR$(13), which is a carriage return code. This is used as a delimiter in our file, so that each entry in the file is placed on a new line, that is, if the file were read back by the text editor, each entry would appear as if on a new line.

The open files are later closed with a CLOSE statement. The words END-OF-FILE are written at the end of file 2 in line 270, just before it is closed.

Line 350 contains a special form of a file input statement in TSC BASIC that allows entry of an entire line into the string variable A$, including commas and quotes. In most BASICs, data entry would stop at the first comma in the text. If your BASIC does not have the INPUT LINE statement or its equivalent, the easiest remedy is to use some other delimiter—such as periods or semicolons—in the original source file and use a plain INPUT instead.

Many BASICs have an easy way of detecting the end of a file; but TSC treats it as an error that must be detected by an ON ERROR statement. This is done in line 330, which sends all following errors to line 690 at the end of the program.

In the last five lines of the program, ERL is a variable that points to the line number where the error occurred, and ERR is a code number specifying the error. These steps go to the return in line 730 on error 8 (end-of-file) in line number 350; on any other error, an error message is printed in line 700.

The Scheduling Program

The Scheduling program (Listing 2) is based on a menu selection from these eleven possible actions:

NEW—Erase the schedule for the student being currently scheduled.

TAKE xxx—Put section xxx into the student's schedule. If this causes a conflict between this section and some section previously scheduled, an error message is printed, but the section is still scheduled.

REMOVE xxx—Remove section xxx from this student's schedule.

PRINT—Print the week's schedule as it currently exists.

TRY xxx—Try out section xxx to see if it fits into the schedule, but don't actually put it into the schedule.

FIND xxx—Find a section of course xxx that fits into the schedule as it exists. There are two options to this function: one prints only those sections that fit; the other prints all sections and identifies conflicts.

CLOSE xxx—Close section xxx. When a section is full of students, we close it. The section remains in the listing, but its name is enclosed in brackets. This gives the user the option of forcing a student into a class even when closed, but clearly signals those sections not available.

OPEN xxx—Opens a section previously closed.

ADDFILE—Used to add a new section to the existing course file stored in memory. For example, when all sections of a required course are closed, it may be necessary to schedule a new section and put it into the file. ADDFILE only stores it in memory, not in the course file on the disk.

SAVEFILE—Stores the course file from memory onto the disk. This would normally be used after the ADDFILE adds a new course.

FEED—Executes a series of line feeds to move printer output up so the schedule just printed can easily be torn off.

As before, array CN$(200) holds up to 200 course and section names, and CT(200,6) holds their times.

Listing 2. Scheduling program in TSC BASIC.

```
0100 REM P. STARK VERSION 3-28-80
0110 REM THIS PROGRAM CHECKS FOR TIME CONFLICTS
0120 REM CN$=COURSE NAME, CT=TITLE, CL=COURSE NO LIMIT

0130 DIM CN$(200),CT(200,6) : CL=200

0140 REM WK IS ARRAY FOR EACH HOUR OF THE WEEK

0150 DIM WK(5,12)                              :REM 5 DAYS, 1 TO 12 O'CLOCK
0160 DIM DA$(5)                                :REM DAYS OF THE WEEK
0170 DA$(1)="MONDAY" : DA$(2)="TUESDAY"
0180 DA$(3)="WEDNESDAY" : DA$(4)="THURSDAY"
0190 DA$(5)="FRIDAY"
0200 GOSUB 1540                                :REM GO READ "COURSES FILE" INTO ARRAYS
0210 GOSUB 1810                                :REM ERASE WK

0220 REM MAIN COMMAND LOOP

0230 PRINT "SELECT -"
0240 PRINT "  SAVEFILE    - SAVE COURSE FILE BACK ON DISK"
0250 PRINT "  OPEN XXX    - OPEN COURSE XXX"
0260 PRINT "  CLOSE XXX   - CLOSE COURSE XXX"
0270 PRINT "  PRINT       - PRINT CURRENT SCHEDULE"
0280 PRINT "  NEW         - ERASE CURRENT SCHEDULE"
0290 PRINT "  TRY XXX     - TRY COURSE XXX FOR CONFLICT"
0300 PRINT "  TAKE XXX    - TAKE COURSE XXX"
0310 PRINT "  REMOVE XXX - REMOVE COURSE XXX FROM SCHEDULE"
0320 PRINT "  FIND XXX    - FIND COURSE XXX WHICH FITS"
0330 PRINT "  ADDFILE     - ADD COURSE TO COURSE FILE"
0340 PRINT "  FEED        - PAPER FORM FEED"
0350 INPUT "COMMAND ", A$
0360 IF LEFT$(A$,8)="SAVEFILE" THEN GOSUB 1690 : GOTO 350
0370 IF LEFT$(A$,4)="OPEN" THEN GOSUB 1290 : GOTO 350
0380 IF LEFT$(A$,5)="CLOSE" THEN GOSUB 1410 : GOTO 350
0390 IF LEFT$(A$,5)="PRINT" THEN GOSUB 2050 : GOTO 350
0400 IF LEFT$(A$,3)="NEW" THEN GOSUB 1810 : GOTO 350
```

Sample Schedule

The sample run uses the following six courses:

CA11A	Mon 11, Wed 11, Fri 11
CA11B	Mon 11, Wed 10, Fri 11
CA11/W	Wed 8, Wed 9, Wed 10 (3 hrs.)
CA11/ML	Mon 2, Mon 3, Mon 4 (3 hrs.)
DS114C	Mon 3, Wed 3, Thu 3, Fri 3
PS201A	Tue 12, Wed 2, Thu 12

The sample run shows how to pick a suitable student program from this limited selection. The program prints the menu, which is not printed after every command, but can be obtained any time by entering an invalid command.

The first command is NEW, which erases the current program. In response, the pro-

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gram asks for a student name, which will be saved until you ask for a printout. Putting the name on the printed schedule personalizes the student's schedule.

Since there is only one DS114 and PS201 section in this simple example, the next two lines TAKE these sections. (If we were to ask for a printout at this point, those two courses would be shown.)

Now we want to find suitable sections of CA11. We need a lecture class (CA11A or CA11B) as well as a lab (CA11/W or CA11/ML). So we ask the computer to FIND CA11. Since we don't want a listing of conflicting sections, the computer tells us that CA11A, CA11B and CA11/W are OK. Notice that it doesn't include CA11/ML, because this course conflicts with DS114C, one of the courses we have already chosen. So, in the next line we TAKE CA11A.

But we still need a lab, so we ask the computer to FIND CA11/. In the FIND command, the course number entered after the word FIND is matched against the first characters of all courses in the file. If we try to FIND CA, then all courses that begin with CA will be found; FIND CA11 will look through all CA11 courses—lecture and lab. FIND CA11/ looks through only lab courses such as /W and /ML. In this way, we can selectively scan through available courses.

In response to the question of PRINT CONFLICTING COURSES?, we answer YES this time and get a complete printout which shows that CA11/W has no conflict, but CA11/ML has a conflict with DS114C on Monday at 3. So we TAKE CA11/W and then ask for a printout of the actual schedule with the PRINT command.

The bottom of the sample also shows the operation of the TRY command, which tells us whether we can schedule a given course without actually putting it in the schedule.

Modifications for Other Computers

Because of the nature of TSC BASIC, this program has one limitation that you can remove when you use other BASICs. We used TSC BASIC in this example because of its speed, but were limited to six or so significant digits.

When the COURSES.FIL file is read, the course and section names are stored in the CN$ array, and the corresponding times for *each section* are stored in the CT array. For instance, the fifth course name read is in CN$(5), while the times are in CT(5,1) through CT(5,6). The first subscript in these arrays (5, in this example, but it can be as high as 200) is a pointer that is also used in scheduling.

When you TAKE a course, that course pointer is put into the WK array, which is dimensioned as WK(5,12), where the first subscript is the day and the second is the hour. For example, if the fifth course is

```
0410 IF LEFT$(A$,4)="TAKE" THEN GOSUB 730 : GOTO 350
0420 IF LEFT$(A$,6)="DELETE" THEN GOSUB 1060 : GOTO 350
0430 IF LEFT$(A$,6)="REMOVE" THEN GOSUB 1060 : GOTO 350
0440 IF LEFT$(A$,3)="TRY" THEN GOSUB 840 : GOTO 350
0450 IF LEFT$(A$,4)="FIND" THEN GOSUB 2370 : GOTO 350
0460 IF LEFT$(A$,7)="ADDFILE" THEN GOSUB 2580 : GOTO 350
0470 IF LEFT$(A$,4)="FEED" THEN GOSUB 2760 : GOTO 350
0480 GOTO 230                                   :REM IF WRONG COMMAND

0490 REM ROUTINE TO FIND NAME XXX IN INPUT STATEMENT
0500 REM ON EXIT, B$ HOLDS NAME RECOVERED FROM A$

0510 IF MID$(A$,PT,1)<>" " GOTO 550
0520 PT=PT+1
0530 IF PT<LEN(A$) GOTO 510                     :REM STEP PAST SPACES
0540 PRINT CHR$(7);"COURSE NAME NOT FOUND" : CN=0 : RETURN
0550 B$=""                                      :REM WILL HOLD NAME
0560 IF PT>LEN(A$) GOTO 610
0570 IF MID$(A$,PT,1)=" " GOTO 610
0580 B$=B$+MID$(A$,PT,1)                        :REM ADD NEXT CHARACTER
0590 PT=PT+1
0600 GOTO 560
0610 CN=1 : RETURN

0620 REM ROUTINE TO FIND NAME B$ (WITH OR WITHOUT [)
0630 REM IN CN$ ARRAY; ON EXIT, CN POINTS TO IT

0640 C$="["+B$+"]"
0650 FOR I=1 TO NC
0660     CN=I
0670     IF CN$(I)=B$ THEN RETURN
0680     IF CN$(I)=C$ THEN RETURN
0690 NEXT I
0700 GOTO 540                                   :REM IF NOT FOUND

0710 REM TAKE ROUTINE - TAKE COURSE XXX AND PUT INTO
0720 REM COURSE SCHEDULE

0730 PT=5                                       :REM POINT PAST KEYWORD
0740 GOSUB 510                                  :REM GO FIND COURSE NAME
0750 IF CN=0 THEN RETURN
0760 GOSUB 640                                  :REM FIND COURSE NAME IN CN$
0770 IF CN=0 THEN RETURN
0780 GOSUB 1910                                 :REM PUT COUTSE CN IN SCHEDULE
0790 IF ER=0 THEN RETURN                        :REM IF NO CONFLICT
0800 PRINT CHR$(7);"CAUTION - CONFLICT"
0810 RETURN

0820 REM TRY ROUTINE - TRY COURSE XXX TO SEE IF IT
0830 REM LEADS TO CONFLICT

0840 PT=4                                       :REM POINT PAST KEYWORD
0850 PF=1                                       :REM TURN ON PRINT FLAG
0860 GOSUB 510                                  :REM FIND COURSE NAME
0870 IF CN=0 THEN RETURN
0880 GOSUB 640                                  :REM FIND COURSE NAME IN CN$
0890 IF CN=0 THEN RETURN

0900 REM ALTERNATE ENTRY POINT FOR FIND

0910 ER=0                                       :REM RESET ERROR FLAG
0920 FOR I=1 TO 6
0930     IF CT(CN,I)=0 GOTO 1020
0940     DA=INT(CT(CN,I)/100)
0950     HR=CT(CN,I)-DA*100
0960     IF WK(DA,HR)=0 GOTO 1010
0970     IF PF=0 GOTO 1000                      :REM CHECK PRINT FLAG
0980     PRINT CHR$(7);"   CONFLICT WITH ";CN$(WK(DA,HR));
0990     PRINT " ON ";DA$(DA);" AT ";HR;" O'CLOCK."
1000     ER=1
1010 NEXT I
1020 IF PF=0 GOTO 1040                          :REM CHECK PRINT FLAG
1030 IF ER=0 THEN PRINT "NO CONFLICT"
1040 RETURN

1050 REM ROUTINE TO DELETE A COURSE FROM SCHEDULE

1060 PT=7                                       :REM POINT PAST KEYWORD
1070 GOSUB 510                                  :REM FIND COURSE NAME
1080 IF CN=0 THEN RETURN
1090 GOSUB 640                                  :REM FIND COURSE NAME IN CN$
1100 IF CN=0 THEN RETURN
1110 FOR I=1 TO 6
1120     IF CT(CN,I)=0 GOTO 1260
1130     DA=INT(CT(CN,I)/100)
1140     HR=CT(CN,I)-DA*100
1150     IF WK(DA,HR)<>0 GOTO 1180
1160     PRINT CHR$(7);B$;" NOT IN SCHEDULE"
1170     GOTO 1250
1180     IF WK(DA,HR)=CN THEN WK(DA,HR)=0 : GOTO 1250
1190     IF WK(DA,HR)>0 GOTO 1160               :REM SOME OTHER COURSE
1200     WK(DA,HR)=-WK(DA,HR)                   :REM GET BACK OTHER COURSE
```

```
1210     IF WK(DA,HR)<>CN GOTO 1250
1220     PRINT CHR$(7);"CAUTION - JUST LOST A COURSE ON"
1230     PRINT DA$(DA);" AT ";HR;" O'CLOCK."
1240     WK(DA,HR)=0                              :REM REMOVE WRONG COURSE
1250 NEXT I
1260 PRINT B$;" DELETED."
1270 RETURN

1280 REM ROUTINE TO OPEN A CLOSED COURSE

1290 PT=5
1300 GOSUB 510                                    :REM FIND COURSE NAME
1310 IF CN=0 THEN RETURN
1320 GOSUB 640                                    :REM FIND COURSE NAME IN CN$
1330 IF CN=0 THEN RETURN
1340 C$=CN$(CN)                                   :REM COURSE NAME
1350 IF LEFT$(C$,1)="[" GOTO 1380
1360 PRINT CHR$(7);C$;" ALREADY OPEN"
1370 RETURN
1380 CN$(CN)=MID$(C$,2,LEN(C$)-2)
1390 RETURN

1400 REM ROUTINE TO CLOSE AN OPEN COURSE

1410 PT=6
1420 GOSUB 510                                    :REM FIND COURSE NAME
1430 IF CN=0 THEN RETURN
1440 GOSUB 640                                    :REM FIND COURSE NAME IN CN$
1450 IF CN=0 THEN RETURN
1460 C$=CN$(CN)                                   :REM COURSE NAME
1470 IF LEFT$(C$,1)<>"[" GOTO 1500
1480 PRINT CHR$(7);C$;" ALREADY CLOSED"
1490 RETURN
1500 CN$(CN)="["+C$+"]"
1510 RETURN

1520 REM ROUTINE TO READ "COURSES.FIL" FILE INTO ARRAYS -
1530 REM CN$ IS NAME, CT IS COURSETIMES

1540 OPEN OLD "COURSES.FIL" AS 1
1550 FOR I=1 TO CL
1560     INPUT #1, A$
1570     IF A$="END-OF-FILE" GOTO 1650
1580     NC=I
1590     CN$(I)=A$
1600     FOR J=1 TO 6
1610         INPUT #1, CT(I,J)
1620     NEXT J
1630 NEXT I
1640 PRINT CHR$(7);"MAXIMUM OF ";CL;" COURSES REACHED"
1650 CLOSE 1
1660 RETURN

1670 REM ROUTINE TO WRITE ARRAYS BACK INTO COURSES.FIL
1680 REM FILE ON DISK

1690 OPEN NEW "COURSES.FIL" AS 2
1700 FOR I=1 TO NC
1710     PRINT #2, CN$(I);CHR$(13);
1720     FOR J=1 TO 6
1730         PRINT #2, CT(I,J);CHR$(13);
1740     NEXT J
1750 NEXT I
1760 PRINT #2, "END-OF-FILE"
1770 CLOSE 2
1780 PRINT "O.K."
1790 RETURN

1800 REM ROUTINE TO ERASE WK ARRAY

1810 FOR I=1 TO 5
1820     FOR J=1 TO 12
1830         WK(I,J)=0
1840     NEXT J
1850 NEXT I
1860 INPUT "ENTER STUDENT NAME", N$
1870 RETURN

1880 REM ROUTINE TO PUT COURSE NO. CN INTO ARRAY WK;
1890 REM RETURN WITH ER=0 IF OK, ER=1 IF OVERLAP
1900 REM AND MAKE COURSE NO MINUS IF SO

1910 ER=0
1920 FOR I=1 TO 6                                 :REM FOR UP TO SIX HOURS
1930     IF CT(CN,I)=0 THEN RETURN                :REM RETURN WHEN DONE
1940     DA=INT(CT(CN,I)/100)                     :REM DAY
1950     HR=CT(CN,I)-DA*100                       :REM HOUR
1960     IF WK(DA,HR)=0 GOTO 2000                 :REM CHECK IF EMPTY
1970     WK(DA,HR)=-WK(DA,HR)                     :REM SET FLAG IF CONFLICT
1980     ER=1
1990     GOTO 2010
2000     WK(DA,HR)=CN                             :REM PUT IN COURSE NUMBER
```

scheduled for Wednesday at 10 o'clock, then WK(3,10) is set to 5.

Suppose you then take a second course that conflicts at this same time. We signal the conflict by changing the 5 to a −5. (When the schedule is printed, this will be signaled by a row of asterisks.)

If you REMOVE the second course, the −5 will change back to a 5, and everything is back to normal. If you delete the first course and leave the second, the −5 will be erased and all trace of the second course will disappear at that hour. So, in case you TAKE a conflicting course, remove the last course taken first. (The program does print an error message—see line 1220—if you do it in reverse, but by then the damage is done.)

In BASICs that allow more than six digits of precision, the program can be modified to encode both course numbers in WK rather than just one. For example, if course 5 and course 37 are both scheduled at the same time, the entry in WK could be 005037 or 037005. It's easy to remove one but leave the other.

You can also expand the program to keep a tally of students and courses. The easiest way is to add a new command, such as TALLY, which would scan the WK array, and write out to a separate disk file the name of the student and the courses he is scheduled for.

We haven't implemented this expansion for two reasons. First, our registration takes place in the gym under unfavorable conditions. We need long extension cords for power. Since power failure is an ever-present possibility, keeping a disk file open for hours is not a good idea. We may, however, switch to a cassette serial file, where power failure would do little harm.

Second, our students frequently switch courses, so we need a way of changing file entries and deleting courses to keep the file current. With 200 course entries held in the two arrays in memory at all times, there is not enough memory to add all these functions.

We are considering transferring this program to a TRS-80 and placing an entire batch of these systems in the gym at once. Several machines could be used for scheduling with this program and would keep tallies, while one or two other systems would be used strictly for changes and deletions. Each of these systems would produce its own cassette tape, and a master program (run at night) would read all these cassettes, one after another, and produce a single, corrected disk file from them.

But this is an idea for the future. One big advantage of small personal systems over the big IBM machines is that we can start small and gradually expand as we gain experience. ■

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```
2010 NEXT I
2020 RETURN

2030 REM ROUTINE TO PRINT A WEEK'S SCHEDULE FROM THE
2040 REM DATA STORED IN ARRAY WK

2050 PRINT : PRINT
2060 PRINT "        COMPUTERIZED REGISTRATION - E. T. DEPARTMENT"
2070 PRINT : PRINT
2080 PRINT N$ : PRINT                              :REM PRINT STUDENT NAME
2090 PRINT "HOUR       MONDAY     TUESDAY    WEDNESDAY";
2100 PRINT "  THURSDAY   FRIDAY"
2110 PRINT
2120 A$="AM"
2130 FOR HR=8 TO 11
2140     GOSUB 2260
2150 NEXT HR
2160 A$="NOON"
2170 HR=12
2180 GOSUB 2260
2190 A$="PM"
2200 FOR HR=1 TO 4
2210     GOSUB 2260
2220 NEXT HR
2230 PRINT : PRINT
2240 RETURN

2250 REM ROUTINE TO PRINT DATA FOR 5 DAYS, 1 HOUR

2260 PRINT HR; A$;
2270 FOR J=1 TO 5
2280     IF WK(J,HR)=0 GOTO 2320                   :REM NO CLASS
2290     IF WK(J,HR)<0 THEN B$="*****" : GOTO 2310
2300     B$=CN$(WK(J,HR))                          :REM COURSE NAME
2310     PRINT TAB(11*J);B$;                       :REM PRINT COURSE NAME
2320 NEXT J
2330 PRINT
2340 RETURN

2350 REM FIND ROUTINE - FIND A COURSE XXX WHICH FITS
2360 REM INTO EXISTING SCHEDULE

2370 PT=5                                          :REM POINT PAST KEYWORD
2380 GOSUB 510                                     :REM FIND COURSE NAME IN INPUT LINE
2390 IF CN=0 THEN RETURN
2400 INPUT "PRINT CONFLICTING COURSES", C$
2410 IF C$="YES" THEN PF=1 : GOTO 2440             :REM PRINT FLAG
2420 IF C$="NO" THEN PF=0 : GOTO 2440
2430 GOTO 2400
2440 C$="["+B$
2450 LE=LEN(B$)
2460 FOR CN=1 TO NC                                :REM SEARCH THROUGH COURSE NAMES
2470     IF LEFT$(CN$(CN),LE)=B$ GOTO 2500
2480     IF LEFT$(CN$(CN),LE+1)<>C$ GOTO 2540

2490     REM FOUND COURSE, SO CHECK IT

2500     IF PF=1 THEN PRINT CN$(CN);" - ";
2510     GOSUB 910                                 :REM GO TRY OUT THE COURSE
2520     IF PF=1 GOTO 2540
2530     IF ER=0 THEN PRINT CN$(CN);" IS O.K."
2540 NEXT CN
2550 RETURN

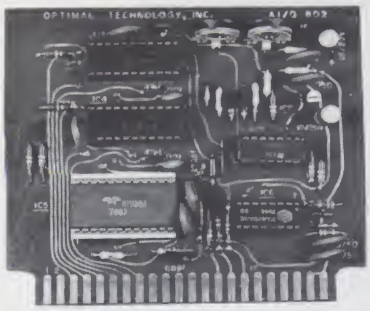
2560 REM ADDFILE ROUTINE TO ADD ANOTHER COURSE TO THE
2570 REM COURSE FILE IN MEMORY

2580 IF NC=CL THEN PRINT "NO ROOM" : RETURN
2590 PRINT "USE NUMBERS FOR DAYS (1=MONDAY ETC.)"
2600 INPUT "ENTER COURSE NAME/SECTION", CN$(NC+1)
2610 FOR I=1 TO 6
2620     PRINT "ENTER DAY";I;", 0 TO END";
2630     INPUT DA
2640     IF DA=0 GOTO 2690
2650     INPUT "ENTER HOUR", HR
2660     IF HR=0 GOTO 2690
2670     CT(NC+1,I)=DA*100+HR
2680 NEXT I
2690 INPUT "OK TO STORE", A$
2700 IF A$="NO" THEN PRINT "CANCELLED" : RETURN
2710 IF A$<>"YES" GOTO 2690
2720 NC=NC+1
2730 PRINT "O. K."
2740 RETURN

2750 REM ROUTINE TO FORM-FEED PRINTER TO MOVE UP PAPER

2760 FOR I=1 TO 44
2770     PRINT
2780 NEXT I
2790 RETURN
```

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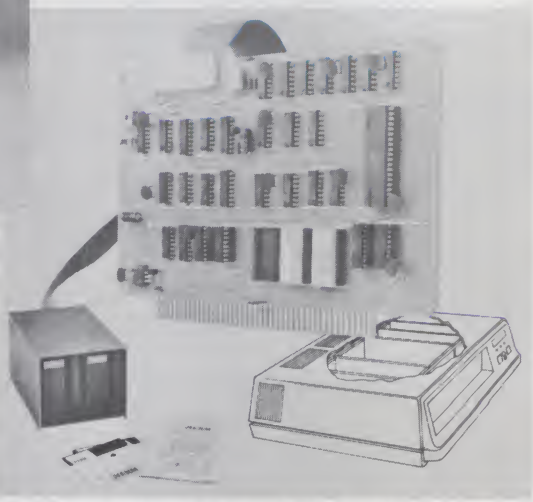
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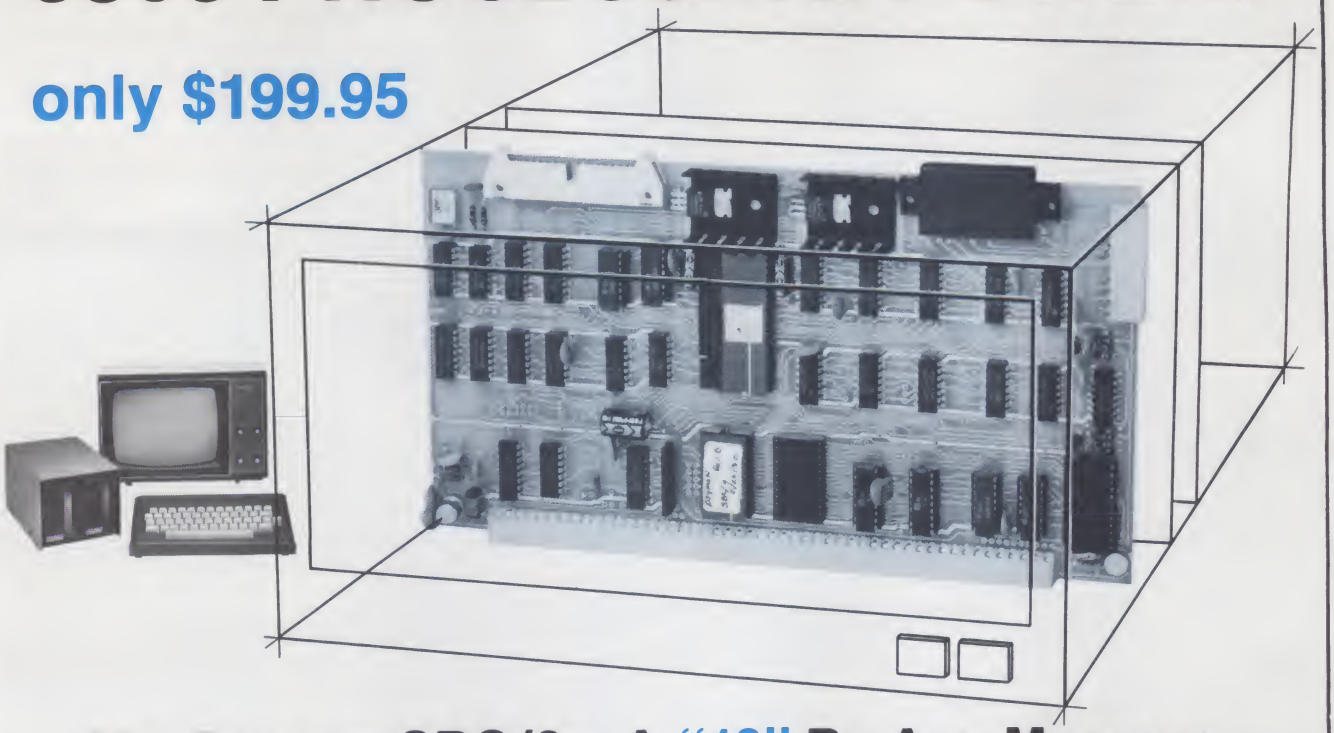
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Plug the SBC/9™ into your SS-50 system bus, and just that easily you've upgraded to the new super-fast super-powerful 6809 MPU with such programming amenities as 10 addressing modes, 16-bit instructions, auto-increment/auto-decrement and position-independent code. Plus, you now have extended addressing capability, and operation under control of PSYMON™, the most powerful and flexibile 1K ROM 6809 operating system yet written.

Percom SYstem MONitor

PSYMON™ provides the usual ROM monitor functions in 1 Kbyte. It is easily extended and customized because its unique "look-ahead" program structure first searches an alternate command table. The table, if present, may be used to redefine or extend PSYMON's™ command set.

And with PSYMON™, I/O is easily directed to any peripheral device — even a disk system — through a Device Control Block table located in memory. This allows you to leave the details of I/O software to the separate I/O device drivers.

A PSYMON™ ROM is included free with the purchase of an SBC/9™. The Users Manual includes a source listing.

The 1 Kbyte ROM monitor for the SBC/9™ 6802 option includes a primary set of typical 6800-compatible monitor commands. As for PSYMON™, the commands are easily extended or modified.

Products are available at Percom dealers nationwide. **Call toll-free, 1-800-527-1592, for the address of your nearest dealer, or to order direct.** Prices and specifications subject to change without notice.

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Project Pegasus—a simulated round-trip exploration of Mars using computer programs to assume landings and takeoffs as well as interplanetary flight.

Everett Q. Carr, Claire J. Carr
Herkimer BOCES Planetarium
Gros Blvd.
E. Herkimer NY 13350



Computer Survival Course for Kids

A summer course for talented kids to help them cope with the coming "computer age."

If you're going to teach seventh and eighth graders computer programming, what are we supposed to teach them when they are freshmen?" We heard this lament from three different school administrators: a high school principal, the dean of a two-year college and the math and science department head of a liberal arts college. The answer to all three questioners is to the point, "It's a matter of survival—theirs and yours."

Everett Q. Carr, planetarium director at the Herkimer (NY) BOCES Educational Complex, directs multidiscipline programs for gifted/talented children from grades 4 through 12.

Introduction

Seventh and eighth graders are at the age—according to the eminent child psychologist, Piaget—when they can deal simultaneously with the abstract concepts, the cognitive content and the interactive environment provided by microcomputers as an instruction medium and a tool in a student's skill kit. Still, it is difficult to communicate the extent of the changes computer power can effect in the present school curricula. Revamping the mathematics education system is just one example.

Pencil and paper routines used to teach children arithmetic are neither fundamental nor efficient. They are just rote methods of getting the right answer . . . unfortunately, not all the time because the arithmetic is actually an additional rote mental process. The pencil applied to paper is merely the scoreboard of the process.

Furthermore, this fundamental approach fails almost totally, beyond obtaining square roots, unless log and trig tables are available. Most microcomputers have log and trig functions built-in to a precision and in-use reliability far better than the average school tables.

Staying Alive

The crux of the matter is survival. The kids are eagerly grabbing the first generation of full-feature appliance computers. Parents ask, "What use is there for a computer?" Teachers question, "How do I teach programming when I don't know how to program myself?"

But survival is chancy. For certain, the future is almost never a linear extrapolation of the present—more people, more cars, more jobs, more of everything that we have now. Change is exponential and explosive. Worse yet, it is unpredictable and virtually uncontrollable. Hard as one may try to predict the future and its limits, the unknowns are often just beyond current knowledge.

Consider the last two years, during which the number of people learning to program computers increased by a factor of 100 times. Until 1977, the rank of computer programmers was limited by the high cost and low availability of computer systems. Even in 1979, universities



What has 40 legs, 1460 keys and asks questions? A classroom of young computerists learning BASIC programming.

were awarding master's degrees in computer science to graduate students who had never actually had a computer to operate. They had been trained to program with pencil and paper and sometimes even to operate a Hollerith card punch, which was fed by an operator when machine time became available. There was no interaction between the person and machine.

Low-cost computers changed that, and the interactive programming process allows people of entirely different personalities to program computers. The sheer number of programmers now in training with high-level languages on so many computers creates an incredible societal change in itself. Low-cost computers have already made programming a hobby—even a pastime—and removed it from the realm of the industrial-media complex.



Students generally loathed the necessary hours of classroom lectures, but loved Sue Culbert's individualized attention when they ran into a problem.

Classroom Computers

In the spring of 1978 it was difficult to obtain delivery of any of the big three appliance computers designed for volume production. By our school district definition, an appliance computer was a complete functioning system, preferably self-contained, operating in a standard BASIC in ROM. By the spring of 1979, the big three—the Radio Shack TRS-80, 16K; the Commodore PET 2001, 8K; and the Apple II, 16K—were readily available.

Our school system had selected, tested and found the Commodore PET satisfactory. In our area, the school system had begun in 1978 with two PET computers for a teacher orientation and a classroom lending program. On this base, and with the addition of a third unit, 17 teachers had each received 14 hours of individual instruction with the PET. Every participating school had a loan computer for a minimum of 20 school days. Each of more than 600 students had access to a computer for at least ten hours. The result was that school administrators, teachers and an enthusiastic group of students wanted to move forward.

To demonstrate the idea that schools should think in terms of filling a classroom with computers, we sought and obtained a small grant for an experimental intensive summer course for gifted/talented seventh, eighth and ninth graders. Twenty students selected by participating schools would have access to 20 PET 2001 computers for about 40 hours. In this grade span it was necessary to cover the fundamental principles of algebra, trigonometry and geometry.

But the course was intended to be multidiscipline, and the necessary mathematics base was integrated in computer program applications in geography, astronomy, space travel and a simulated round trip exploration of Mars. A set of computer programs simulated landings and takeoffs as well as the interplanetary flight. The simulation took place in a planetarium where the special-effects projectors and a mock-up of the interplanetary vehicle array added realism to the exercise. The course outline is given in Table 1.

Course Objectives

1. To learn the fundamental principles of BASIC programming with a microcomputer.
2. To apply BASIC programming techniques in the high school curriculum, extra curricula activities and to personal requirements.
3. To supply a student with a sufficient base to proceed independently in programming study and application.

Course Outline

		Hours: 8:30 AM to 12:30 PM
Day 1	8:30- 9:30	Parents Meeting—Program Director
		Student Orientation—Staff
	9:30-12:30	The PET Computer
Day 2	8:30- 9:30	The Elements of Algebra
	9:30-12:30	CAI BASIC
Day 3	8:30- 9:30	The Elements of Algebra
	9:30-12:30	CAI BASIC
Day 4	8:30- 9:30	The Elements of Geometry
	9:30-12:30	CAI BASIC
Day 5	8:30- 9:30	The Elements of Trigonometry
	9:30-12:30	CAI BASIC/Text Assignments
Day 6	8:30- 9:30	Applications—Graphics
	9:30-12:30	CAI BASIC/Text Assignments
Day 7	8:30- 9:30	Application—Problems In Geography
	9:30-12:30	Text Assignments—Sports
Day 8	8:30- 9:30	Applications—Simulations In Sociology
	9:30-12:30	Text Assignments—Astronomy of the Sun
Day 9	8:30- 9:30	Applications—Space Travel
	9:30-12:30	Applications—Mars Flight Simulation/Planetarium
Day 10	8:30- 9:30	Computer Careers
	9:30-12:30	Applications In High School

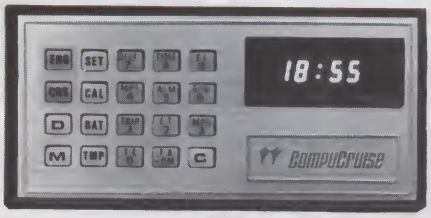
"CAI-PET BASIC Compleat," *The Paper*, Box 43, Audubon PA 19407.
Text: Thomas A. Dwyer, Margot Critchfield, *BASIC and the Personal Computer*, Addison-Wesley Publishing Co., Reading MA 1978.

Table 1. Computer survival course for seventh, eighth and ninth grade students.

In our 15,000-student school system, we had forecast that in this, the second year, there would be 20 computers for the children at the secondary level. There will actually be 42 computers in the system. The five-year forecast is for 756 computers in this system on the basis of full school use—through the elementary grades for computer-aided instruction; in the middle schools, with a fundamental course in program integration with a mathematics and science curriculum; and in the high school, with advanced courses in programming with a wide range of multidiscipline applications.

Ambitious? No. It's a matter of survival in a new age. ■

If you enjoy driving, you're going to get a COMPUCRUISE. Once you see what it can do, you just won't be able to live without it.



This gadget fits into most dashboards . . . no strain even in a tiny sports car like the Mazda RX-7 . . . and once you have it, every trip is like flying a 747. The darned thing tells you the time, how fast you're going, how far you've been on this trip or since the last regassing, how many miles per gallon you're getting, either at the instant or the average on the trip . . . or gallons per hour at the moment or for the trip . . . temperature outside . . . inside (or coolant temperature, if you prefer) . . . oh, it has an elapsed time for the trip, a stop watch, lap time, an alarm . . . how much further for your trip, how many gallons more the trip will take, how much longer for the trip at your present average speed . . . yes, it gives you your average speed for the trip. You prefer it in metric, no strain . . . liters remaining, etc. Did we mention that it also has cruise control either at a speed set on the control board or at whatever speed you are traveling? The Compucruise will keep you busy and entertained during any trip . . . telling you more than you will ever want to know.

The Compucruise is not difficult to install . . . though it does connect to everything except the cigarette lighter. Until you've tried computerized travel, you haven't found out how much fun driving can be. It will work on any car not having fuel injection . . . and there is a front-wheel drive accessory gadget available for only $4.40-#P001 (regularly $5.50).

The price for the Compucruise is regularly $199.95 . . . and a bargain at that price. We'll sell you one of these fantastic gadgets for $159.95 with cruise control (Model 44-#P002), and $127.95 without (Model 41-#P003).Send money . . . and start having fun!

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PROCESSOR TECH SOFTWARE

2 ★ **Processor Tech Extended Disk BASIC**—This is full disk BASIC on 8" disk for HELIOS II disk controllers with PTDOS and greater than 16K. #D015S-$70 each.

1 ★ **Extended Disk BASIC on cassette**—This is the same as previously mentioned for the Disk BASIC from Processor Tech. Needs more than 16K. #D017S-$62.

4 **Extended Cassette BASIC**—This includes all file operations, advanced functions for doing more than playing games, for SOLOS, CUTTER, and CONSOL Monitors. #D016-$22 each.

16 **BASIC 5 from Processor Tech**—This is a simple BASIC for a SOLOS, CUTTER, or CONSOL Monitor and 8K of RAM. #D013-$11.60 each.

4 **Processor Tech GAMEPAC** for above BASIC—Various simple games. #D014-$10.00 each.

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4 ★ **SOL Computers**—8K RAM Monitor, S-100, excellent condition. #D004S-$950 each.

17 **TREK-80** on cassette for SOL—This is one of the best real time space games available today; needs 8K. #D005-$11 each.

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2 ★ **Compucolor Computer 8001** (use as computer or 75 MHZ Color Monitor)—8K RAM, BASIC and DOS in ROM, good condition. #S025S-$1400 each. **SPECIAL PRICE.**

2 ★ **Compucolor MiniFloppy**—5¼ inch, good condition. #S026S-$500 each. **SPECIAL PRICE.**

4 ★ **Compucolor 8K RAM card**—Static RAM, good condition. #S027S-$190 each. **SPECIAL PRICE.**

3 ★ **Compucolor Floppy Tape Drive**—Uses eight-track cartridges, good condition. #S028S-$60 each. **SPECIAL PRICE.**

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10 ea	Mem-2	16K Memory Board (2114)	26.95	22.95	#LP003
10 ea	EPM-2	2708/2716 EPROM Board	25.95	21.95	#LP004
10 ea	EPM-1	1702 EPROM Board	25.95	21.95	#LP005
10 ea	RTC-1	Real Time Clock	23.95	20.50	#LP006
10 ea	QM-9	The Little Mother (9 slot)	30.95	26.50	#LP007
10 ea	QM-12	The Quite Mother (12 slot)	34.95	29.95	#LP008
5 ea	FDC-1	Floppy Disk Board	42.95	36.95	#LP009
7 ea	FPB-1	Front Panel (IMSAI size)	44.50	37.95	#LP010
1 ea	EPM-1	1702 EPROM Board (asmbld) without EPROMS	49.95	42.50	#LP011

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2 ★ **ICOM FDOS-II on 8" Disk for S-100**—Requires an ICOM S-100 controller in an S-100 cabinet, no documentation. #D033S-$170 each.

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↙Reader Service—see page 257

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The current explosion of sales of personal computers has gone beyond the hobby market to include business and education. Computer-assisted instruction is the prime purpose for placing a computer in the classroom. Computers are useful not only for helping students, but also for easing teachers' work loads. Teachers can enter their gradebooks into that box and let it add points, figure grades and churn out class lists of various data.

That's what I do with my personal computer. It provides me with the latest information when parents call; it informs the students of their current progress (or lack of it); and it makes due days for deficiency reports or semester grades just another day, instead of a dreaded deadline.

I take about 30 minutes at the end of each week to enter or update various scores. Then the computer is set to the task of producing a list of missing work that is eventually posted on the bulletin board and a list of current grades that is filed in my gradebook. Every few weeks I make available a copy of the grades identified by book number only, so each student knows his score and how far away he is from the next grade.

If you own a computer or have access to one at school, consider using this program to ease the task of record keeping. Note that I do not advocate using a computer to *replace* the gradebook. It just helps in interpreting the mess of tiny, colorful marks that fill that book.

Program Operation

Scores is a menu-oriented program. I wrote this program to work on a 6800 system with Smoke Signal Broadcasting's disk system, Computerware BASIC and an 80-column printer on port #7. You will have to make appropriate changes as you enter the program into your system. It begins by asking for the date—used for labeling any reports—and then gives you a choice of tasks. You can change or add data or select INFORMATION to get a second menu for various listings.

SETTING UP A NEW CLASS is used once for each class period. The computer will prompt for the class name and ask for the name and book number for each student. Entering a ZZZ for a student's name will signal the end of the class list, and the program will return to the menu. If you entered an incorrect name or book number, finish entering the class roster and then go to CHANGE ERRORS to make the correction.

ADD A NEW STUDENT will place the new name and book number at the end of the class list, where it usually ends up in your gradebook. Test scores for the new student are entered automatically as zeros with the last test flagged as a −5. The computer uses this flag to figure grades based on subsequent tests—not on the whole year.

If and when you obtain grades from the student's previous class, you can use CHANGE INDIVIDUAL SCORE to replace −5 with the cumulative prorated points in line with the rest of the class.

DROP A STUDENT will delete a name and all scores from the class roster. Confirmation is required before the deletion is made. The student's current points and grade average will be listed for your information.

INSERT NEW TEST SCORES is the heart of the program. It is used to enter a set of grade points for the whole class. I suggest jotting down the test number in your gradebook for future reference. Enter the total number of points possible (maximum of 999), the date (use exactly five characters—three for the month and two for the day, e.g., JUN05) and a short description of the test or source of points (adding fractions, chapter 3, homework, etc.). The computer will prompt for each of these entries.

If later you discover an error, use CHANGE ERRORS to correct it. This information is stored in one long string variable, so the change is made by reentering the whole string.

When ready for the scores, the computer will print each student's name and a question mark. Enter the points for that name. If the grade is missing, enter −1. This flag is used to generate a report of all missing work. At the end of the class roster you will be asked if you have another set of grades for the same class; if not, you are then returned to the menu.

CHANGE INDIVIDUAL SCORES is used to enter the points of work that were missing or to correct a score. There are prompts for the class name, student name and test number. The computer will respond with the current number of points it has for that test and ask for the new number.

To save time, the computer does not return to the beginning of the class list to search for each name or test number. This is usually no problem for me because I refer to the previous week's list of missing work to update the records, and all names and tests on that list are in order.

INFORMATION will provide you with the following choice of reports:

SINGLE STUDENT'S GRADE will give you just that on the terminal.

LIST OF MISSING TESTS will search the scores of a given class for flagged grades and send the data to the printer in the form of name, possible points, date and a description of the missing work. I post this list weekly and then use it to update the files.

GRADE LISTING BY BOOK NUMBER calculates the grade for each student and produces a listing on the printer of the current grading scale and the total points and grade of every student identified only by a book number. An asterisk points out those entries that have missing work. In figuring the grades, the computer gives missing work zero points—a harsh but effective stimulus for getting the work made up.

Finally, GRADE LISTING BY NAME will produce a list on the terminal or printer of all the grades identified by name. I run this weekly and keep a copy in my gradebook for ready *reference*.

A BASIC program printed in a magazine is like a piece of unfinished furniture—the difficult work has been done, but time

and effort are still needed to make it a finished product suitable for your use.

Modifications

The grading scale appears in lines 8320-8350 and in lines 9520-9550. Although percentages are used to figure grades, the grading scale is given in the form of points needed for each grade. Any fractional part of the percentage is truncated. For example, 90 percent of 125 is 112.5, but if 90 percent is considered an A grade, then 112 points is sufficient for the A.

My disk system has two drives: drive #0 for the program and drive #1 for the class files. There should be no problem if you have only one disk drive. The program and class files fit neatly on one disk with room to spare . . . or use two disks and switch them after entering the program.

The disk commands I use are OPEN, CLOSE, READ, WRITE, SCRATCH and RESTORE. In addition, FREN renames a file and FDEL deletes a file. Since my BASIC uses only sequential files and I have limit-

Program listing.

```
0001 PRINT "*****************************************"
0002 PRINT "**                                     **"
0003 PRINT "**            SCORES                   **"
0004 PRINT "**              BY                     **"
0005 PRINT "**          CHARLES KAZA               **"
0006 PRINT "**                                     **"
0007 PRINT "*****************************************"
0010 DIM T$(32)
0015 LINE= 64
0060 INPUT "TODAY'S DATE";X$
0100 REM MENU OF TASKS AVAILABLE
0110 HOME
0120 PRINT "1--SET UP NEW CLASS"
0130 PRINT "2--ADD A NEW STUDENT"
0140 PRINT "3--DROP A STUDENT"
0150 PRINT "4--INSERT NEW TEST SCORES"
0160 PRINT "5--CHANGE INDIVIDUAL SCORE"
0170 PRINT "6--INFORMATION"
0180 PRINT "7--CHANGE ERRORS"
0185 PRINT "8--FINISHED"
0190 INPUT "ENTER # OF YOUR CHOICE";Z
0200 ON Z GOTO 1070,5500,5700,2000,3100,210,6000,9999
0210 HOME
0220 PRINT "1--SINGLE STUDENT GRADE"
0230 PRINT "2--LIST OF MISSING TESTS"
0240 PRINT "3--GRADE LISTING BY BOOK #"
0250 PRINT "4--GRADE LISTING BY NAME"
0260 PRINT "5--FINISHED"
0270 INPUT "ENTER # OF YOUR CHOICE";Z
0280 ON Z GOTO 4100,4500,4700,5000,9999
1000 REM SET UP CLASS LIST
1070 GOSUB 9010
1075 OPEN #1,F$:WRITE#1,0
1080 PRINT "ENTER NAME AND BOOK NUMBER FOR EACH STUDENT."
1090 PRINT "'LAST NAME' SPACE 'FIRST NAME'"
1100 PRINT "TO END ENTER 'ZZZ'"
1110 INPUT "NAME";N$
1120 IF N$="ZZZ"THEN1160
1130 INPUT "BOOK #";B
1140 WRITE #1,N$,B
1150 GOTO 1110
1160 CLOSE #1
1170 GOTO 100
2000 REM ADD A SET OF SCORES
2010 GOSUB 9010
2020 OPEN #1,F$
2030 OPEN #2,1:TEMP
2040 SCRATCH #2
2050 READ #1,T
2060 IF T=0THEN2100
2070 FOR I=1TOT
2080 READ #1,T$(I)
2090 NEXT I
2100 LET T=T+1
2105 PRINT "TEST #";T
2110 INPUT "MAXIMUM # OF POINTS",P:IFP>999THEN2110
2115 LET A$="000"+STR$(P):A$=RIGHT$(A$,3)
2120 INPUT "DATE (MONDA)",D$
2130 INPUT "DESCRIBE TEST",P$
2140 LET T$(T)=A$+D$+P$
2150 WRITE #2,T
2160 FOR I=1TOT
2170 WRITE #2,T$(I)
2180 NEXT I
2190 READ #1,N$
2195 IF STATUS#1=6THEN2290
2200 WRITE #2,N$
2210 FOR I=1TOT
2220 READ #1,P1
2230 WRITE #2,P1
2240 NEXT I
2250 PRINT N$;
2260 INPUT " POINTS",P
2270 WRITE #2,P
2280 GOTO 2190
2290 GOSUB 9110
2292 INPUT "ANOTHER TEST SAME CLASS (Y-N)",A$
2294 IF A$="Y"THEN2020
2295 GOTO 100
3000 REM INDIVIDUAL SCORE CHANGE
3100 GOSUB 9210
3110 INPUT "ENTER NAME OF STUDENT",M$
3120 READ #1,N$
3130 IF STATUS#1=6THEN3180
3140 IF N$=M$THEN3200
3150 WRITE #2,N$
3160 LET I1=1:I2=T+1:GOSUB8000
3170 GOTO 3120
3180 PRINT "NAME NOT ON CLASS LIST"
3190 GOTO 3400
3200 INPUT "CHANGE SCORE ON TEST #",S
3210 WRITE #2,N$
3220 LET I1=1:I2=S:GOSUB8000
3230 READ #1,P
3240 PRINT "CURRENT SCORE FOR TEST #";S;"IS ";P
3250 INPUT "NEW SCORE IS",P
3260 WRITE #2,P
3265 IF S = T THEN 3330
3270 INPUT "ANOTHER CHANGE FOR SAME PERSON Y-N",A$
3280 IF A$="N"THENI1=S+1:I2=T:GOSUB8000:GOTO3330
3290 INPUT "CHANGE IN TEST #",S1
3300 IF S1=S+1THENS=S1:GOTO3230
3310 LET I1=S+2:I2=S1:S=S1:GOSUB8000
3320 GOTO 3230
3330 INPUT "ANOTHER STUDENT Y-N",A$
3340 IF A$="Y"THEN3110
3350 READ #1,N$
3360 IF STATUS#1=6THEN3400
3370 WRITE #2,N$
3380 LET I1=1:I2=T+1:GOSUB8000
3390 GOTO 3350
3400 GOSUB 9110
3420 GOTO 100
4000 REM INDIVIDUAL GRADES
4100 GOSUB 9310
4105 INPUT "STUDENT'S NAME",M$
4110 READ #1,N$
4120 IF STATUS#1=6THEN4350
4130 IF N$=M$THEN4180
4140 FOR I=1TOT+1
4150 READ #1,P
4160 NEXT I
4170 GOTO 4110
4180 READ #1,B
4190 LET P2=0
4200 FOR I=1TOT
4210 READ #1,P
4220 IF P>=0THEN4250
4230 LET P=0:PRINT"MISSING A TEST WORTH ";
4240 PRINT VAL(LEFT$(T$(I),3));" POINTS"
4245 PRINT "DATE ";MID$(T$(I-1),4,5);" ";MID$(T$(I),9)
4250 LET P2=P2+P
4260 NEXT I
4280 GOSUB 8300
4290 PRINT "CURRENT GRADE IS ";G$
4300 PRINT P2;"POINTS OUT OF ";P1
4310 INPUT "ANOTHER NAME Y-N",A$
4320 IF A$="Y"THENGOSUB4030:GOTO4105
4330 CLOSE #1
4340 GOTO 100
4350 PRINT "CAN'T FIND NAME"
4360 GOTO 4310
4500 REM LIST MISSING SCORES
4503 LINE= 100
4504 PRINT #7
4505 FOR I=1TO3:PRINT#7,"MISSING WORK ";X$;:NEXTI
4510 GOSUB 8100
4530 SKIP #7,2:PRINT#7,TAB(15);MID$(F$,3):PRINT#7
4540 READ #1,N$
4550 IF STATUS#1=6THEN4660
4570 FOR I=1TOT+1
4580 READ #1,P
4590 IF P>=0THEN4640
4595 IF P<-4THEN4640
4600 PRINT #7,N$;
4605 PRINT #7,TAB(20);
4610 PRINT #7,VAL(LEFT$(T$(I-1),3));"PTS ";
4620 PRINT #7,MID$(T$(I-1),4,5);" ";MID$(T$(I-1),9)
4640 NEXT I
4650 GOTO 4540
4655 PRINT #7
4660 CLOSE #1
4670 INPUT "ANOTHER CLASS Y-N",A$
4680 IF A$="Y"THEN4510
4685 PRINT #7
4690 GOTO 100
4700 REM GRADES LISTED BY BOOK #
```

EXATRON STRINGY FLOPPY
Owners Association Newsletter

Secretary, Fred Waters

THE EXATRON STRINGY FLOPPY

The ESF is a mass storage subsystem for microcomputers. It does the same thing for you as a disk subsystem, or as an audio cassette machine. Let's look at rate, reliability, and cost. When compared to an audio cassette machine, the ESF loads and saves at 7200 baud, or 800 bytes per second, in contrast to 500 baud, or 56 bytes per second. The ESF is highly reliable—it's very difficult to test the error messages!—and your programs can be saved or loaded hundreds of times without error. When compared to a disk subsystem, the Stringy Floppy costs maybe one quarter as much—and it's ready to operate as soon as you install it and plug it in. There you have it—rapid, reliable, inexpensive, and simple to operate.

THE STORY

In the summer of 1977, Bob Howell, head of Exatron and the inventor and designer of the Stringy Floppy, started putting into hardware the ideas he had had for some time. That fall we both worked on the software—a 1K utility program to control the essential functions: read, write, verify, certify, and append. By November Bob had a working prototype, and from that point on, I had an ESF continuously at home, in user test or simply in use, in my IMSAI 8080. The first Stringy Floppy was the S-100 version. ESFOA—the Exatron Stringy Floppy Owners Association—was formed among a close group of participants and contributors in the development phase, and the first ESFOA Newsletter was published in January 1978. Early members of ESFOA were mostly engineers, technicians, programmers, and homebrew enthusiasts here in Silicon Valley, and the Stringy Floppy has been the target of enthusiastic attention and creative imagination from the first. Production and sales started, and the ESF was shown at the Second West Coast Computer Faire in March 1978.

Since then a lot has happened. There are ESFs for the SS-50 bus (this one in particular with magnificent software support); for the TRS-80, with both the hardware and firmware custom designed to meet the needs of the average TRS-80 user, and NOW THE MICRO-SPONGE! (More below.) The point is that during these 2½ years the S-100 model has been continuously improved and augmented, as to useful features, software support, and reliability.

THE S-100 STRINGY FLOPPY

Just run down this list of features for a fast, reliable, and low-cost mass storage subsystem: double-density storage, so you get a baud rate of 14,400, and can save or load 16K in 12 seconds; on-board utility firmware, so all you need to start up your system is to turn the power on and reset-and-go; multi-drive capability, so you can have several ESFs under a single operating system; a gem of a machine language monitor—and complete source with detailed comments for both the utility firmware and the monitor; power-on jump, phantom, and jumper options for panelless micros; fast-forward controlled by software: and an active users group including a wide range of professionals in related industry.

A significant benefit of the S-100 version of the ESF is the range of readily available software support at slight additional cost. This includes an Advanced Programmers Guide, for those who want to pursue assembly language programming; a Relocating and Linking Loader; ESFTOS, a Tape Operating System, for exploitation of the full file and data handling of the ESF, with multiple drives if wanted; a 5K Assembler, Editor, and Monitor, with source listing and the Intel Assembly Language Programming Manual for the 8080; and a 16K Extended BASIC which uses ESFTOS for interface. There is more, but this gives you an idea.

NOW THE MICRO-SPONGE

The S-100 version was the first Stringy Floppy. The latest version, to round out the family of ESFs, is the MICRO-SPONGE. This one is truly the Intelligent Stringy Floppy—it is controlled by its own on-board microprocessor. The interface is the international standard, the RS-232. Only four wires are required: transmit data, receive data, clear-to-send, and ground. The easy-to-use protocol consists of only four basic functions: read, write, go to beginning of tape (rewind), and space file forward. All mass storage functions for programs, operating systems, and data files can be put together with these basic functions. Baud rate is selectable within the specified range, and goes to 9600. This means data transfer of 5.3K bytes in 4.5 seconds to or from a 5-foot wafer. There is also a fast forward controlled by software command.



Pictured above is the Exatron Stringy Floppy MICRO-SPONGE.

If you have one of the microcomputers for which no Stringy Floppy has yet been specifically produced—Exatron has been flooded with inquiries on this—the MICRO-SPONGE is your answer. Just hang an RS-232 interface on your computer if you don't already have one, and use this general-purpose ESF. If yours is a homebrew system, or a single-board computer, this is for you. It is also an ideal choice for OEM applications, and for commercial or industrial uses—instrumentation, monitoring devices, portable computers, or just about any application where quick storage and readout or mass program material or data is needed.

WHAT'S YOUR PLEASURE?

If you own or use a microcomputer, there is a Stringy Floppy you can use. A recent survey shows that a very high percentage of buyers of disk systems don't really need or want that full capability, nor want to spend that much money. These must be the escapees from the world of audio cassette machines, with the attendant problems of slow loading and saving, rewind, slow verification, repetition until it works, frustration, and frayed nerves! Give yourself a break. Explore all the possibilities of the Exatron Stringy Floppy that best suits your needs. And don't overlook the quality of a product, or the confidence of a manufacturer, where you get an unconditional, no-questions-asked, 30-day money-back guarantee, and a one-year full warranty. For information on any of these problems, call on the Hot Line below.

INFORMATION & ORDERS

The ESF is assembled and tested at the factory, with a 30-day moneyback guarantee and a one-year full warranty. For fastest delivery, phone in your credit card or COD order using the toll-free line below.

Base price for the TRS-80 ESF, $249.50 (ask about the Starter Kit); for the S-100 ESF, $289.50; and for the complete SS-50 package (described in detail in last month's N/L), $499. The RS-232 compatible MICRO-SPONGE is $349.50 with substantial discounts for OEM quantities. Info packets at no charge; TRS-80 (only) users manuals are $3 for shipping and handling.

If you have any questions about these products, about Exatron or ESFOA please call the Hot Line. Address letters to ESFOA, 3559 Ryder St., Santa Clara, CA 95051.

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EXATRON STRINGY FLOPPY

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```
4710 GOSUB 9310
4715 LINE= 100
4720 PRINT #7
4730 PRINT #7,TAB(10);MID$(F$,3);TAB(18);"CURRENT GRADES AS OF ";X$
4740 RJUST= 3
4750 SKIP #7,1
4760 LET L=7
4770 GOSUB 9510
4810 SKIP #7,2
4820 GOSUB 8400
4830 PRINT #7,TAB(30);
4840 GOSUB 8400
4850 LET C=0:PRINT#7
4860 READ #1,N$
4870 IF STATUS#1=6THEN4980
4880 GOSUB 9410
4960 GOSUB 8500
4970 IF C=30THEN4850
4975 LET C=30:GOTO4860
4980 CLOSE #1
4985 INPUT "ANOTHER CLASS Y-N",A$
4990 IF A$="Y"THENSKIP#7,5:GOTO4700
4992 PRINT #7
4995 GOTO 100
5000 REM GRADE LISTING BY NAME
5010 HOME
5020 PRINT "1--TV LISTING"
5030 PRINT "2--PRINTED LISTING"
5040 INPUT L
5050 IF L=2THENL=7
5060 GOSUB 9310
5065 LINE= 100
5070 PRINT #L
5080 PRINT #L,TAB(5);MID$(F$,3);TAB(14);"CURRENT GRADES AS OF ";X$
5090 RJUST= 3
5100 GOSUB 9510
5150 PRINT #L
5160 IF L=1THENINPUTA$:HOME
5170 LET C=0
5175 LET C1=0
5180 READ #1,N$
5190 IF STATUS#1=6THEN5340
5195 GOSUB 9410:GOTO5280
5200 READ #1,B
5210 LET P2=0:A=0:P9=0
5220 FOR I=1TOT
5230 READ #1,P3
5235 IF P3>-5THEN5240
5236 LET P3=0:P9=1:GOSUB8600
5240 IF P3<0THENP3=0:A=1
5250 LET P2=P2+P3
5260 NEXT I
5265 IF P9=0THEN5270
5267 LET P8=P1:P1=P4:GOSUB8300
5268 LET P1=P8:RETURN
5270 GOSUB 8300
5275 RETURN
5280 PRINT #L,TAB(32*C1+1);N$;TAB(32*C1+20);P2;TAB(32*C1+25);G$;
5290 IF A=1THENPRINT#L,"***";
5300 IF C1=0THENC1=1:GOTO5180
5305 PRINT #L
5310 IF L=7THEN5175
5320 LET C=C+1:IFC<7THEN5175
5330 GOTO 5160
5340 PRINT #L:CLOSE#1
5350 INPUT "ANOTHER CLASS Y-N",A$
5360 IF A$="Y"THEN5060
5370 GOTO 100
5500 REM ADD A NEW STUDENT
5510 GOSUB 9210
5520 READ #1,N$
5530 IF STATUS#1=6THEN5570
5540 WRITE #2,N$
5550 LET I1=1:I2=T+1:GOSUB8000
5560 GOTO 5520
5570 INPUT "NAME OF NEW STUDENT",N$
5580 INPUT "BOOK #",B
5590 WRITE #2,N$,B
5595 IF T=1THEN5630
5600 FOR I=1TOT-1
5610 WRITE #2,0
5620 NEXT I
5630 WRITE #2,-5
5640 INPUT "ANOTHER NAME (Y-N)",A$
5650 IF A$="Y"THEN5570
5660 GOSUB 9110
5670 GOTO 100
5700 REM DROP A STUDENT
5710 GOSUB 9310
5712 CLOSE #1
5715 GOSUB 3020
5720 INPUT "NAME OF STUDENT TO BE DROPPED",M$
5730 READ #1,N$
5740 IF STATUS#1=6THEN5880
5750 IF N$=M$THEN5790
5760 WRITE #2,N$
5770 LET I1=1:I2=T+1:GOSUB8000
5780 GOTO 5730
5790 PRINT "DELETE ";N$;" (Y-N)";
5800 INPUT A$
```

ed memory, updating data is accomplished by READing a class file and WRITEing to a temporary file.

The WRITE command includes new data and skips deleted data. When the end of the class file is reached, that class file is deleted and the temporary file is renamed as the new class file. While the computer runs through a class roster, there are periodic pauses for a read or write to disk. Toward the end of the semester, expect pauses between each name. They are brief and barely slow down data entry.

The test headings are kept in a string array, T$(30). The following functions manipulate strings and may have to be changed to suit your version of BASIC.

VAL(X$) turns the string X$ into a number—X$ must contain only numbers.

STR$(X) turns the number X into a string.

LEFT$(X$,n) takes the left n characters of the string.

RIGHT$(X$,n) takes the right n characters of the string.

MID$(X$,n,p) takes the middle p characters of the string starting with the nth character.

+ is used to join two strings into one.

Some other peculiarities of my system include a HOME command that clears the terminal screen and places the cursor in the upper-left corner. There is a LINE command that the computer uses to avoid breaks in the middle of a word when printing long messages.

In using this command, I have assumed a minimum of 64 characters per line on both the terminal and printer. Multiple statements are allowed with a colon (:) as the separator. When an IF . . . THEN appears on such a line and evaluates a false condition, the computer skips the rest of that line and continues with the next numbered line.

Once you have Scores operating in your computer, don't hesitate to personalize the program. I wrote it to reflect my method of record keeping. If yours is different, make the computer work for you—not the other way around.■

```
5810 IF A$="N"THEN5760
5820 GOSUB 9410
5830 PRINT "CURRENT GRADE OF ";M$;" IS ";G$
5840 PRINT P2;" POINTS OUT OF A MAXIMUM ";P1
5850 INPUT "ANOTHER STUDENT (Y-N)";A$
5860 IF A$="Y"THEN5720
5870 GOTO 5730
5880 PRINT "END OF CLASS "
5890 GOSUB 9110
5900 GOTO 100
6000 REM CHANGE SET UP ERRORS
6010 HOME
6020 PRINT "1--NAME OR BOOK # ERROR"
6030 PRINT "2--TEST HEADING ERROR"
6040 INPUT "ENTER NUMBER OF YOUR CHOICE";Z
6050 ON Z GOTO6130,6400
6130 GOSUB 9210
6140 IF T=0THEN6160
6150 FOR I=1TOT:READ#1,T$:WRITE#2,T$:NEXTI
6160 INPUT "NAME",M$
6170 READ #1,N$,B
6180 IF STATUS#1=6THEN6300
6190 IF N$=M$THEN6240
6200 WRITE #2,N$,B
6210 IF T=0THEN6170
6220 FOR I=1TOT:READ#1,P:WRITE#2,P:NEXTI
6230 GOTO 6170
6240 INPUT "ENTER NAME",N$
6250 INPUT "ENTER BOOK#",B
6260 INPUT "ANOTHER CHANGE (Y-N)";A$
6270 IF A$="N"THEN6200
6280 INPUT "NAME",M$
6290 GOTO 6200
6300 PRINT "END OF CLASS"
6310 GOSUB 9110
6320 GOTO 100
6400 GOSUB 6060
6410 INPUT "CHANGE HEADING IN TEST #",T1
6420 FOR I=1TOT
6430 READ #1,T$(I)
6440 NEXT I
6450 PRINT "ENTER NEW HEADING UNDER OLD"
6460 PRINT TAB(4);T$(T1)
6465 INPUT T$(T1)
6470 INPUT "CHANGE ANOTHER HEADING (Y-N)";A$
6480 IF A$="Y"THEN6410
6490 FOR I=1TOT
6500 WRITE #2,T$(I)
6510 NEXT I
6520 READ #1,N$
6530 IF STATUS#1=6THEN6310
6540 WRITE #2,N$
6550 FOR I=1TOT+1
6560 READ #1,P:WRITE#2,P
6570 NEXT I
6580 GOTO 6520
8000 FOR I=11TO12
8010 READ #1,P
8020 WRITE #2,P
8030 NEXT I
8040 RETURN
8100 GOSUB 9010
8110 OPEN #1,F$
8120 RESTORE #1
8130 READ #1,T
8140 FOR I=1TOT
8150 READ #1,T$(I)
8160 NEXT I
8170 RETURN
8300 REM GRADING SCALE
8310 LET G$="A"
8320 IF P2<INT(P1*.9)THENG$="B"
8330 IF P2<INT(P1*.8)THENG$="C"
8340 IF P2<INT(P1*.65)THENG$="D"
8350 IF P2<INT(P1*.5)THENG$="E"
8360 RETURN
8400 PRINT #7," BOOK#  PTS   GRADE";
8410 RETURN
8500 PRINT #7,TAB(C+2);B;
8510 IF A=1THENPRINT#7,"*";
8520 PRINT #7,TAB(C+9);P2;TAB(C+17);G$;
8530 RETURN
8600 LET P4=0
8610 FOR J=I+1 TO T
8620 LET P4=P4+VAL(LEFT$(T$(J),3))
8630 NEXT J
8640 RETURN
9000 REM GET FILE NAME OF CLASS
9010 HOME
9020 LINE= 64
9030 PRINT "PLACE DISK IN DRIVE #1"
9040 INPUT "NAME OF CLASS (USE UP TO 6 CHARACTERS)";F$
9050 LET F$="1:"+LEFT$(F$,6)
9060 RETURN
9100 REM SUBROUTINE TO CLOSE FILES
9110 CLOSE #1,#2
9115 FDEL F$
9120 LET Y$=MID$(F$,3)
9130 FREN 1:TEMP,Y$
9140 RETURN
```

```
9200 REM SET UP TEMP FILE
9210 GOSUB 9010
9220 GOSUB 9610
9230 IF T=0THEN9295
9270 FOR I=1TO T
9280 READ #1,T$(I)
9285 WRITE #2,T$(I)
9290 NEXT I
9295 RETURN
9300 REM OPEN CLASS FILE TO READ
9310 GOSUB 9010
9320 OPEN #1,F$
9330 RESTORE #1
9340 READ #1,T
9350 LET P1=0
9360 FOR I=1 TO T
9370 READ #1,T$(I)
9380 LET P1=P1+VAL(LEFT$(T$(I),3))
9390 NEXT I
9395 RETURN
9400 REM ADD POINTS FOR GRADE
9410 READ #1,B
9415 LET P2=0:A=0:P9=0
9420 FOR I=1 TO T
9425 READ #1,P3
9430 IF P3=-5THENLETP3=0:P9=1:GOSUB8600
9435 IF P3=-1THENP3=0:A=1
9440 LET P2=P2+P3
9450 NEXT I
9460 IF P9=0THEN9490
9470 LET P8=P1:P1=P4:GOSUB8300
9480 LET P1=P8:GOTO9495
9490 GOSUB 8300
9495 RETURN
9500 REM PRINT GRADING SCALE
9510 PRINT #L,TAB(10);"TOTAL POINTS--";P1
9520 PRINT #L,TAB(13);INT(P1*.9);" PTS--A"
9530 PRINT #L,TAB(13);INT(P1*.8);" PTS--B"
9540 PRINT #L,TAB(13);INT(P1*.65);" PTS--C"
9550 PRINT #L,TAB(13);INT(P1*.5);" PTS--D"
9560 RETURN
9600 REM OPEN R/W FILES
9610 OPEN #1,F$
9620 OPEN #2,1:TEMP
9630 SCRATCH #2
9640 READ #1,T
9650 WRITE #2,T
9660 RETURN
9999 END
```

```
MISSING WORK OCT 18 MISSING WORK OCT 18 MISSING WORK OCT 18

              MATH6

DADAMS JOHN          30 PTS SEP21 SUBTRACT INTEGERS
FADAMS JOHN          30 PTS SEP14 ADD INTEGERS
FADAMS JOHN          30 PTS SEP21 SUBTRACT INTEGERS
GADAMS JOHN          40 PTS SEP28 MULT-DIV. INTEGERS



         MATH6   CURRENT GRADES AS OF OCT 18

         TOTAL POINTS--200
            180  PTS--A
            160  PTS--B
            130  PTS--C
            100  PTS--D


 BOOK#  PTS   GRADE          BOOK#  PTS   GRADE
  12    153     C             23    156     C
 142    151     C             54 *  149     C
  35 *  128     D             29 *  125     D



    MATH6    CURRENT GRADES AS OF OCT 18
          TOTAL POINTS--200
             180  PTS--A
             160  PTS--B
             130  PTS--C
             100  PTS--D

ADAMS JOHN          153  C       BADAMS JOHN         156  C
CADAMS JOHN         151  C       DADAMS JOHN         149  C***
FADAMS JOHN         128  D***    GADAMS JOHN         125  D***
```

Sample run.

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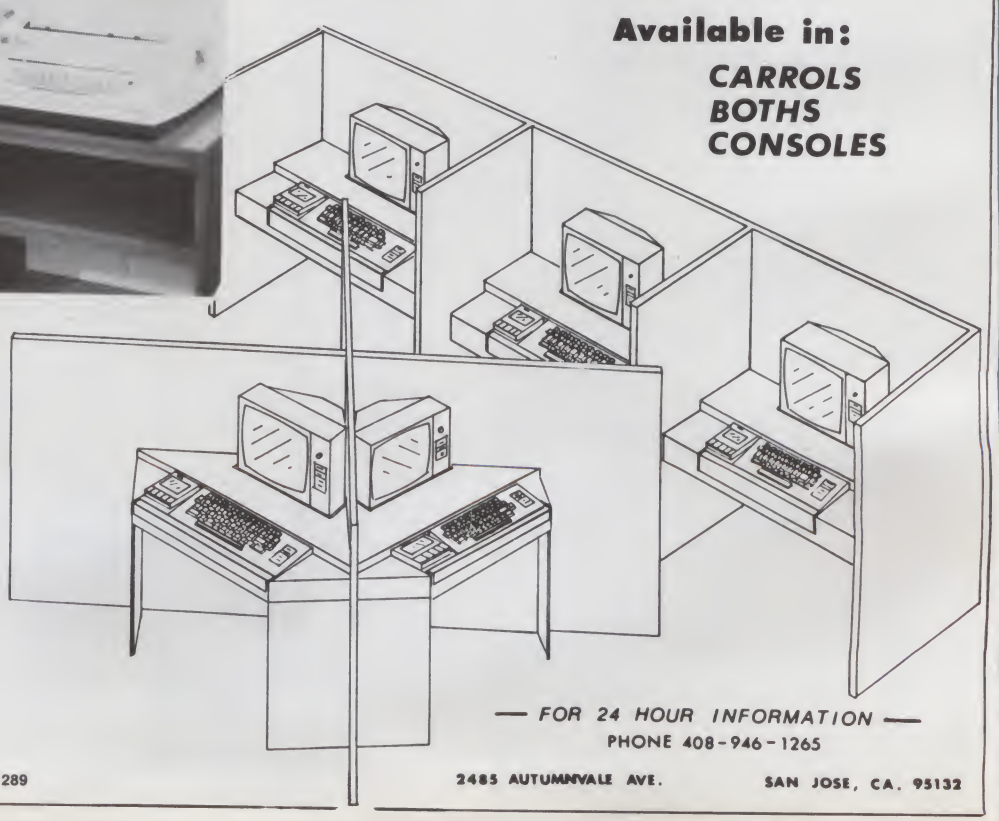


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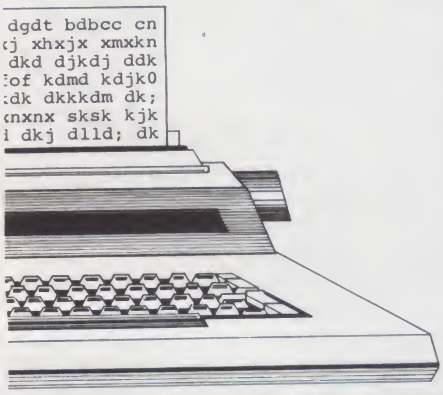
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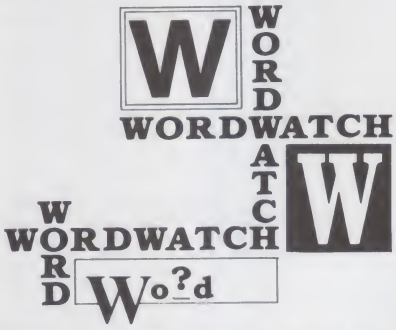
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This package also contains the Teacher Data Transfer program, which allows you to combine several tests on one tape. That means you can learn a number of lessons sequentially without changing tapes.

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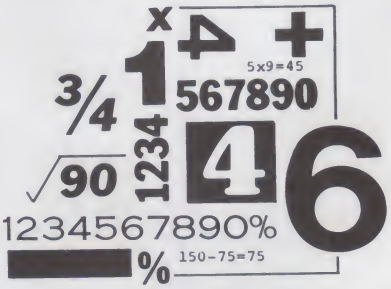
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Math Teacher

Students and their parents can use this long-division practice program at home. Teachers can use it in the classroom. Either way, it should help improve kids' math abilities.

Willis H. Cook
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Cook's Conjecture states that only a small percentage of displays on home computers is useful. The only really useful programs I run are a curve-fitting program that I have used in my work and the program described in this article.

My ten-year-old son can testify that this program works. Fourth-grade long division was about to do him in. It took him hours to do a dozen problems, which were incorrect at that. Now he can breeze through ten problems in about ten minutes, and this program guarantees that they are all correct.

This program is ideal for the child who hates to do battle with division. The built-in prompts tend to keep his attention so that he can finish quickly. This improves the child's confidence. It may not make division problems enjoyable, but at least it will take the trauma out of doing arithmetic homework.

The program, designed to run on an Ohio Scientific C2 4P computer, is strongly display-oriented, and so, machine dependent. It will run without modification on an OSI 8P, but not on a 1P because of its different display format. Enough information about the program operation is given so that you can easily transfer it to any other machine.

Program Features

The program operates by picking two random numbers such that one number is evenly divisible by the other. If you answer the problem correctly, you get another one. If your answer is wrong, you have to repeat the problem.

The program promotes a step-by-step approach to problem solving by asking for answers one digit at a time. Problem solving on the screen occurs just the way it does when it is done by hand. Photo 1 shows the display after a problem has been successfully completed. After a short delay, the display scrolls up, and another problem is presented. The program stops after ten problems.

If, during the course of a problem, you realize that you have made a mistake, you can terminate the problem by entering −1. The same problem is then repeated for another attempt. The program checks intermediate calculations and repeats the problem if it detects an error in calculations.

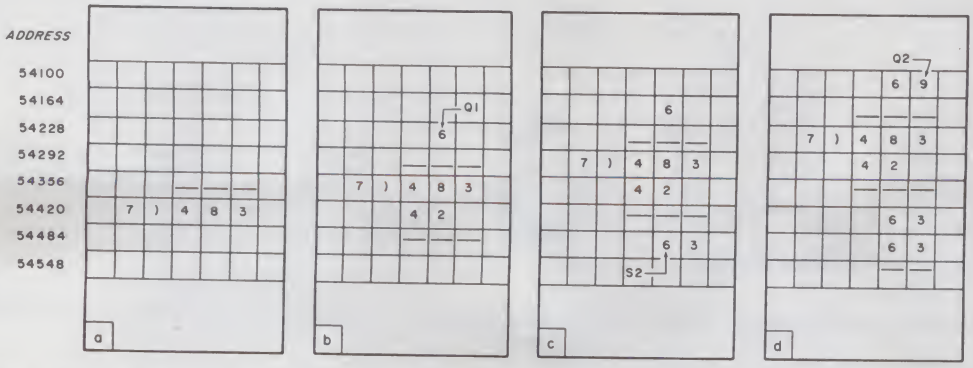
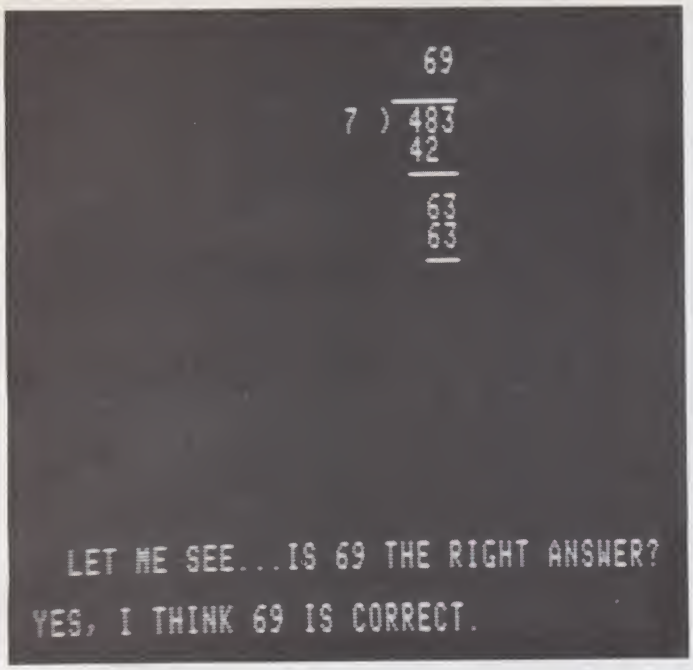


Fig. 1. Display for a problem with a two-digit answer. The display scrolls up one line after each input: a. the problem as originally presented; b. after one input, Q1; c. after two inputs, Q1 and S2; and d. after three inputs, Q1, S2 and Q2. The addresses are for the left-hand memory cell in each diagram. Addresses increase by one left-to-right.

Variables

In line 60 the variable K is the counter that keeps up with the number of problems worked. It is not necessary to initialize its value in Microsoft BASIC, but it is required in some other languages and is generally a good practice.

The variable B is the display memory address of the input prompting character "?" on OSI's system and is used to POKE a blank in its place after an input. This keeps the display from becoming cluttered with extraneous characters as the



Screen display after a problem is completed. All answers come out evenly with no remainders.

problem develops. You will need to determine the value to be used for B on your system. A blank is also put in location B + 2 to erase the input itself. If you enter −1, a third blank is needed in location B + 3.

Y is the divisor, X is the dividend, and Z is the quotient.

Variables Q1, Q2 and Q3 are the individual digits of the answer. S2 and S4 are the results of subtracting the products of Q1, Q2 or Q3 and the divisor from the dividend. These are the inputs for the program, which handles the intermediate multiplications and places the numbers in the correct positions.

S1, S3 and S5 are the products of Q1*Y, Q2*Y and Q3*Y, respectively. They are not input by the user; the program calculates their values. They must also be directed to the proper screen locations with POKE statements.

A1 and A2 are the digits of the dividend that are "brought down" before another division step is made. Instead of just relocating these digits, the program calculates values for the digits by subtracting S1, S2, S3 and S4 from the dividend and checking to see if the result is a single digit. If not, it is evident that an error has been made.

Operation

Lines 100 and 110 establish the values of the divisor (Y) and the dividend (X). These statements utilize a useful formula for determining the range of random numbers generated by the RND function. For a random number C to be within the range A< = C< = B,

C = INT((B − A + 1)*RND(1) + A).

So, line 100 picks divisors between 2 and 9, inclusive:

Y = INT((9 − 2 + 1)*RND(1) + 2)

and line 110 picks dividends between 100 and 899:

X = INT((899 − 100 + 1)*RND(1) + 100).

This information comes from *BASIC and the Personal Computer*, by Dwyer and Critchfield.

Lines 140–160 set up the problem, then scroll up the display ten lines before the first input. The character represented by CHR$(129) is a dash near the bottom of the display cell. CHR$(133) is a dash near the top of the cell. Check to find suitable replacements on your system.

An input is displayed by a POKE statement, as in line 200. The first number after the POKE command is the display memory address. These numbers will depend on your type of system. Determining the proper display addresses will be the biggest problem in translating the program for another computer. The factor +48 used in the POKE statements changes the value of a numeric character to its ASCII value. If your system uses a different scheme, for example, eight-digit ASCII code, this number would change.

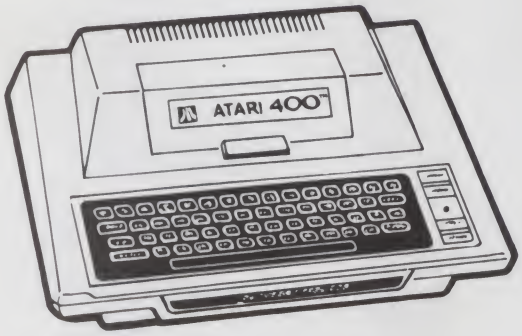
The screen display scrolls up one line after every input, so when you POKE a number to the screen after the first input, you must use the address of the next-higher line. After the second input, use an address two lines higher, and so on. The easiest way to handle this is to make copies of Figs. 1 and 2 us-

```
10 REM  ************************
20 REM  *                      *
30 REM  *   DIVISION PRACTICE  *
40 REM  *                      *
50 REM  ************************
60 FOR A=1 TO 30:PRINT:NEXT A:K=0:B=55040
70 PRINT"  TA DA!  IT'S TIME FOR A LITTLE DIVISION PRACTICE."
80 PRINT"THIS WON'T TAKE LONG.  ALL YOU HAVE TO DO"
90 INPUT"IS GET TEN RIGHT ANSWERS.  ARE YOU READY";A$
100 Y=INT(8*RND(1)+2)
110 X=INT(800*RND(1)+100)
120 Z=X/Y:IF Z<>INT(Z) THEN 110
130 PRINT:PRINT:PRINT:PRINT
140 PRINT TAB(22) CHR$(129);CHR$(129);CHR$(129);CHR$(129)
150 PRINT TAB(18) Y;")";X
160 FOR A=1 TO 10:PRINT:NEXT A
170 INPUT Q1:POKE B,32:POKE B+2,32
180 IF Z>=100 THEN 550
190 REM  DISPLAY ROUTINE FOR ANSWER < 100.
200 POKE 54232,Q1+48
210 S1=Q1*Y
220 POKE 54423,INT(S1/10)+48
230 POKE 54424,S1-10*INT(S1/10)+48
240 POKE 54487,133:POKE 54488,133:POKE 54489,133
250 INPUT S2:POKE B,32:POKE B+2,32
260 IF S2=-1 THEN 830
270 REM  ENTERING -1 ALLOWS THE PROBLEM TO BE RESTARTED.
280 POKE 54488,S2+48
290 A1=X-(S1*10)-(S2*10)
300 IF A1<0 OR A1>9 THEN 520
310 POKE 54489,A1+48
320 INPUT Q2:POKE B,32:POKE B+2,32:IF Q2=-1 THEN 830
330 POKE 54105,Q2+48
340 S3=Q2*Y
350 POKE 54488,INT(S3/10)+48
360 POKE 54489,S3-10*INT(S3/10)+48
370 POKE 54552,133:POKE 54553,133
380 ANS=10*Q1+Q2
390 PRINT:PRINT"  LET ME SEE...IS";ANS;"THE RIGHT ANSWER?"
400 FOR A=1 TO 1200:NEXT A
410 IF ANS=Z THEN 450
420 PRINT:PRINT"I DON'T THINK";ANS;"IS QUITE CORRECT."
430 FOR A=1 TO 1000:NEXT A
440 GOTO 130
450 PRINT:PRINT"YES, I THINK";ANS;"IS CORRECT.":PRINT
460 FOR A=1 TO 1000:NEXT A
470 K=K+1:IF K=10 THEN 490
480 GOTO 100
490 PRINT:PRINT"OK!  THAT'S TEN CORRECT DIVISION PROBLEMS."
500 PRINT"NOW HOW ABOUT A GAME OF STAR TREK?....."
510 END
520 PRINT"I THINK WE HAVE A PROBLEM.  LET'S START OVER."
530 FOR A=1 TO 1000:NEXT A
540 GOTO 130
550 REM  DISPLAY ROUTINE FOR ANSWER > 100.
560 POKE 54231,Q1+48
570 S1=Q1*Y:POKE 54423,S1+48
580 POKE 54487,133:POKE 54488,133
590 INPUT S2:POKE B,32:POKE B+2,32
600 IF S2=-1 THEN 830
610 POKE 54487,S2+48
620 A1=INT((X-S1*100-S2*10)/10)
630 IF A1<0 OR A1>9 THEN 520
640 POKE 54488,A1+48
650 INPUT Q2:POKE B,32:POKE B+2,32:IF Q2=-1 THEN 830
660 POKE 54104,Q2+48
670 S3=Q2*Y
680 POKE 54487,INT(S3/10)+48
690 POKE 54488,S3-10*INT(S3/10)+48
700 POKE 54551,133:POKE 54552,133:POKE 54553,133
710 INPUT S4:POKE B,32:POKE B+2,32:IF S4=-1 THEN 830
720 POKE 54552,S4+48
730 A2=X-(100*Q1+10*Q2)*Y-10*S4
740 IF A2<0 OR A2>9 THEN 520
750 POKE 54553,A2+48
760 INPUT Q3:POKE B,32:POKE B+2,32:IF Q3=-1 THEN 830
770 POKE 53977,Q3+48
780 S5=Q3*Y
790 POKE 54552,INT(S5/10)+48
800 POKE 54553,S5-10*INT(S5/10)+48
810 POKE 54616,133:POKE 54617,133
820 ANS=100*Q1+10*Q2+Q3:GOTO 390
830 POKE B+3,32:GOTO 130
```

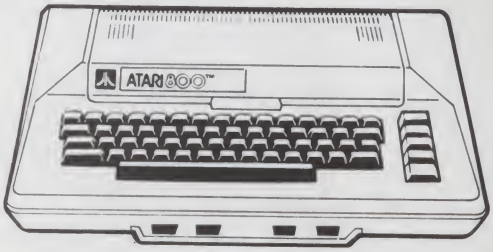
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ing the correct display addresses for your system.

Enter and run the program through line 170 to determine the initial locations. The resultant display will correspond to either Fig. 1a or 2a. The divisor is located at 54421 on my system. Determine the address of this location on your display. Subtract one from this number to obtain the address of the memory cell corresponding to my location 54420 in Figs. 1 and 2.

Knowing (or determining) the address increments for each line of the display will allow you to renumber the figures to agree with your system. Then change each POKE address in the program to your equivalent address. Note that the left-hand memory location in the figures does not correspond to the left edge of the screen.

Modifications

Two independent output routines accommodate the two types of problems the program handles: problems with two-digit answers and those with three-digit answers. Lines 200–380 execute the former, and lines 560–820 execute the latter. The routines are different primarily because the display locations for three-digit answers start one place farther to the left than those of two-digit answers. I attempted to combine these two routines into one to make a more compact and efficient program, but it never worked.

Ohio Scientific computers use a scanned-array keyboard, which allows the keyboard to be programmed to respond to instantaneous key closures, so inputs don't have to be followed by carriage returns. Such a feature makes the program a little easier to use. It would be necessary, however, to replace the INPUT statements with PRINT statements, since the display is set up for the line scrolls that occur after each input.

The carrot-on-the-stick theory is highly regarded in educational programming. When the child finishes the work, give him a reward (see program lines 490 and 500). Call up his favorite computer game, play a tune or dazzle him with one of your outstanding video displays.

The uniform line numbering in the program is due to John Aughey and his article, "Not-So-Fast Renumberer for OSI BASIC" (January 1980 *Kilobaud Microcomputing*, p. 74). ■

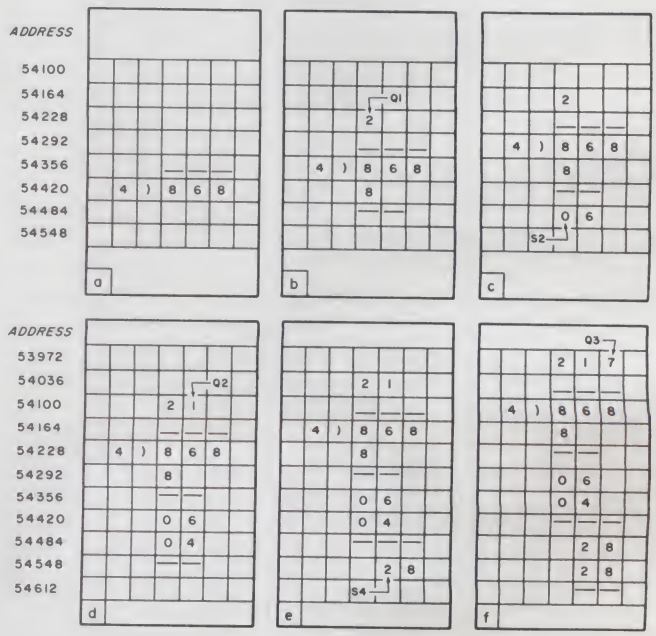


Fig. 2. Display for a problem with a three-digit answer. Each diagram shows how the display changes after every input. Note the different address locations for Q1, S2 and Q2 from those in Fig. 1.

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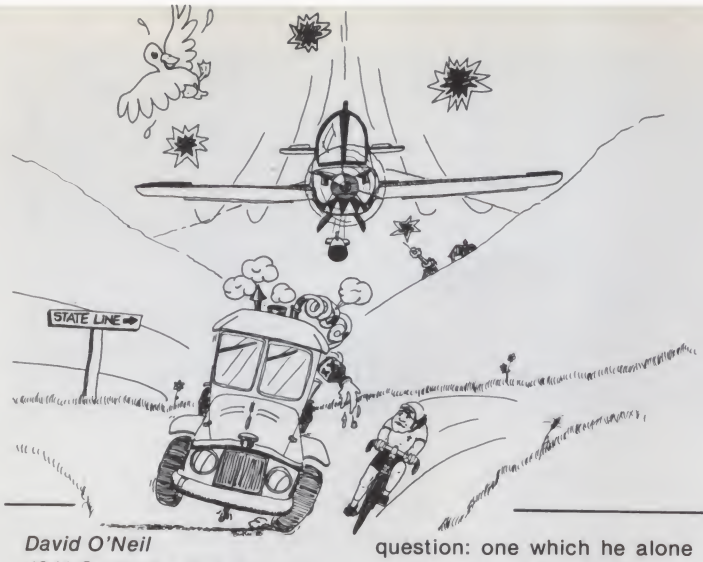
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Physics Teacher

David O'Neil
4241 Centurian Circle
Greenacres FL 33463

The microcomputer is an ideal high-school classroom assistant. The following programs are useful to physics teachers specifically, but will also help other teachers develop their own ideas to really speed up the day's work.

As a teacher, I have wanted to give each student the ideal question: one which he alone can solve and he alone must solve; not the same one everyone else has; not one with the answer in the book; not one without the answer in the book; not one too hard; not one too easy. Enter the microcomputer that can give each student his very own problem.

These programs are written for an SWTP 6800 system with a printer at port 7. Uiterwyck BASIC will go to the line following an untrue IF-THEN statement if it is a multiple-statement line.

Introduction

Most of the programs have more than one mode. First, variables are input by the operator and an answer is printed. This applies to test-item preparation. Second, the programs output individual problems for each student. The correct answer follows. If the problem is printed using PORT = X, the answer can be clipped off and stored for grading. Third, the student can enter what he thinks is the correct answer and the computer can reward or punish him. Fourth, the computer can plot the cannon shot or bomb drop.

Flak

Flak (Program 1) requests or gives the Cartesian coordinates of aircraft and asks the student for the range, bearing and elevation to fire flak cannons to destroy the planes. (See Fig. 1 and Example 1.) Note: no shell drop is figured since flak guns are high-velocity guns usually aimed upward. All this program does is sharpen trigonometry skills by changing Cartesian coordinates into polar. There is no bell for a miss yet. The amount reported as miss is the true space distance from where the student aimed and the aircraft is actually located.

Bomber

Bomber (Program 2) simu-

```
0010 PRINT "FOR AUTOMATIC, RANDOM PRINTOUT"
0011 PRINT "ENTER A  1 "
0012 PRINT "FOR VIDEO TERMINAL INPUT &"
0013 PRINT "OUTPUT, ENTER A  2"
0016 INPUT P
0017 IF P=1THEN PORT=7
0100 PRINT "NO. ";Q
0110 PRINT "AIRCRAFT ARE SPOTTED AT THE"
0120 PRINT "FOLLOWING X,Y & Z COORDINATES"
0121 IF P>1THEN130
0122 LET X=(INT(29*RND(0)+1))*1000
0123 LET Y=(INT(29*RND(0)+1))*1000
0124 LET Z=(INT(29*RND(0)+1))*1000
0125 PRINT "X=";X;"  Y=";Y;"  Z=";Z
0126 GOTO 190
0130 PRINT "X= ";
0140 INPUT X
0150 PRINT "Y= ";
0160 INPUT Y
0170 PRINT "Z= ";
0180 INPUT Z
0190 PRINT "CALCULATE THE BEARING, ELEVATION"
0200 PRINT "AND RANGE TO DESTROY"
0205 PRINT :PRINT:PRINT:GOTO342
0210 PRINT "RANGE = ";
0220 INPUT R
0230 PRINT "ELEVATION = ";
0240 INPUT E
0245 LET E=E/57.29578
0250 PRINT "BEARING = ";
0260 INPUT B
0265 LET B=B/57.29578
0270 LET Y1=SIN(E)*R
0280 LET Z1=SIN(B)*(SQR((R*R)-(Y*Y)))
0290 LET X1=Z/(TAN(B))
0300 LET Y2=Y1-Y
0310 LET Z2=Z1-Z
0320 LET X2=X1-X
0330 LET M=SQR((Y2*Y2)+(Z2*Z2)+(X2*X2))
0335 LET M=INT(M)
0340 PRINT "YOU MISSED BY ";M;" FEET"
0342 LET J=Z/X
0343 PRINT "NO. ";Q
0344 PRINT "TRUE BEARING = ";ATAN(J)*57.29578
0350 LET R1=SQR((Y*Y)+(X*X)+(Z*Z))
0352 LET K=Y/R1
0354 PRINT "ELEVATION =";(ATAN(K/SQR(1-K*K)))*57.29578
0360 PRINT "ACTUAL RANGE = ";R1
0370 PRINT :PRINT
0400 PRINT #1;"AGAIN (YES=1) ";:INPUT#1,G
0405 LET Q=Q+1
0411 IF G=1 THEN 100
0412 PORT= 1
0413 END
```

Program 1. Flak.

```
NO. 0
AIRCRAFT ARE SPOTTED AT THE
FOLLOWING X,Y & Z COORDINATES
X=17000   Y=16000   Z=13000
CALCULATE THE BEARING, ELEVATION
AND RANGE TO DESTROY


NO. 0
TRUE BEARING = 37.4053436
ELEVATION =36.7829339
ACTUAL RANGE = 26720.77
```

Example 1. Flak sample run.

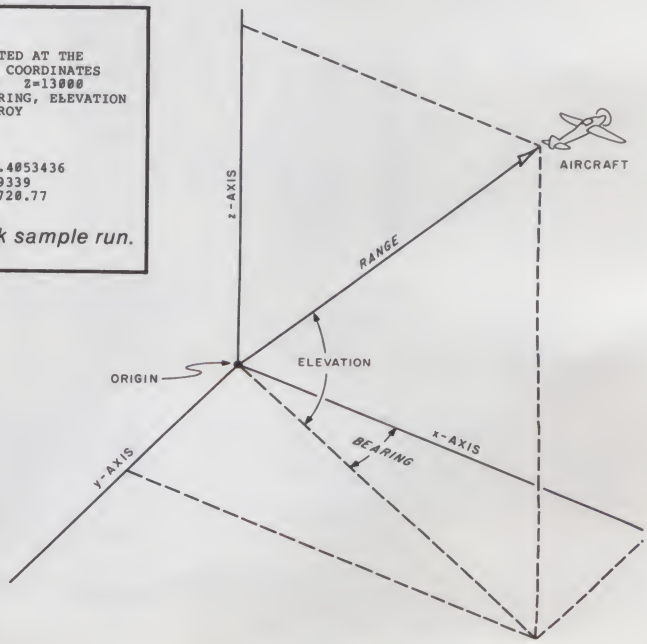


Fig. 1. Diagram of Flak.

```
0005 PRINT "    BOMBARDIER"
0006 PRINT "AUTOMATIC PROBLEM PRINTER (1),"
0007 PRINT "VIDEO GAME (2) OR ONE-PROBLEM"
0008 INPUT "DISPLAY (3)",P
0009 IF P<>1 THEN K=1000:GOTO30
0010 INPUT "NO. OF PROBLEMS ",K
0020 IF P=1 THEN PORT=7
0030 PRINT :IF J=K THEN 360
0031 PRINT
0032 PRINT CHR$(16),CHR$(22)
0033 PRINT "---------"
0035 LET J=J+1
0040 IF P=1 THEN 100
0050 PRINT "INPUT ALTITUDE (IN FEET)"
0055 PRINT "AND SPEED (IN MPH)";
0060 INPUT H,V
0070 GOTO 130
0100 PRINT " BOMBER  ";J
0110 LET H=(INT(24*RND(0)+6)*1000)
0120 LET V=(INT(32*RND(0)+8)*10)
0130 PRINT "YOU'RE FLYING AT ";H;" FEET AT"
0140 LET V1=INT(V*44/30)
0150 PRINT V;" MPH OR ";V1;" FT/SEC"
0160 PRINT "ON A BOMBING MISSION. YOU WILL"
0170 PRINT "HAVE TO RELEASE YOUR BOMBS"
0180 PRINT "WHEN THE TARGET IS X DEGREES"
0190 PRINT "FROM THE VERTICAL."
0200 PRINT "ANGLE X = ";
0205 IF P<>2 THEN 240
0210 INPUT A
0220 LET A=A/57.29578
0230 LET D=TAN(A)*H
0240 LET D1=(SQR(2*H/32))*V1
0241 LET T=SQR(H/16)
0242 LET Z=(2*V1)/(32*SQR((2*H)/32))
0243 PRINT :PRINT:PRINT:PRINTJ
0244 PRINT "ANGLE=";ATAN(Z)*57.29578;"  TIME=";T
0246 LET D1=INT(D1)
0247 LET D=INT(D)
0248 PRINT "DISTANCE HORIZONTALLY = ";D1
 250 IF P<>2 THEN 30
0251 LET W=ABS(D-D1)
0252 LET S=(W/D1)*100
0253 IF S<5THEN256
0254 PRINT CHR$(7)
0255 GOTO 257
0256 PRINT "VERY GOOD !!"
0257 REM BELL=MISS, "VERY GOOD"=HIT
0260 IF D>D1 THEN 330
0270 IF D<D1 THEN 300
0280 PRINT "DIRECT HIT!!!  PERFECT!!"
0290 INPUT "CONTINUE (1)",Z:GOTO360
0300 LET M=D1-D
0310 PRINT "WENT PAST BY ";M; " FEET!!"
0320 INPUT "CONTINUE (1)",Z:GOTO30
0330 LET M1=D-D1
0340 PRINT "FELL SHORT BY ";M1;" FEET!!"
0350 INPUT "CONTINUE (1)",Z:GOTO30
0360 PORT= 1
0370 END
```

Program 2. Bomber Squadron.

```
0050 INPUT "NAME ",N$
0100 PRINT "BOMBER PLOT - ENTER ALTITUDE,"
0110 PRINT "SPEED (MPH) AND ANGLE TO SIGHT"
0120 INPUT H,V,E
0130 LET E=E/57.29578
0135 LET V=V*44/30
0140 LET T1=(TAN(E)*H)/V
0160 PORT= 7
0170 PRINT N$
0210 REM *40* IN LINE 220 IS PRINTER WIDTH+
0220 LET Y=(H-(16*T+T))/(H/40)
0235 IF Y<0THEN310
0238 IF T>=T1THENPRINT"D";:LETT1=9999
0240 PRINT TAB(INT(Y));"+"
0260 LET T=T+1
0300 GOTO 220
0310 IF T>=T1THEN370
0320 IF T1=9999THEN380
0330 LET T=T+1
0340 IF T>=T1THEN370
0350 PRINT
0360 GOTO 330
0370 PRINT "D"
0380 PORT= 1
0390 END
```

Program 2a. Bomber plotter program.

```
BOMBER 1
YOU'RE FLYING AT 28000 FEET AT
250 MPH OR 366   FT/SEC
ON A BOMBING MISSION. YOU WILL
HAVE TO RELEASE YOUR BOMBS
WHEN THE TARGET IS X DEGREES
FROM THE VERTICAL
ANGLE X=


1
ANGLE=28.6705848   TIME=41.833
DISTANCE HORIZ.= 15310
```

Example 2. Bomber Squadron sample run.

lates a bomb drop. For a given flight speed and altitude there is one angle at which the bombardier must sight the target when he releases the bombs to hit the target. This program has three modes, but the plot mode is a separate program. In addition to outputting the correct angle, the program also prints the time the bomb is in the air and the horizontal distance it travels while falling. Straight down is zero degrees, so the angle is measured from vertical. (Sample run is shown in Example 2.)

Program 2a illustrates a Bomber plotter program designed to print on the SWTP PR-40 printer. This simple program requests the student's name and the values for speed, altitude and angle calculated by the student. It then plots the drop lengthwise on the plotter. If the + lands right on the D, it is a direct hit. Of course, due to round-off, it is also a hit if the + falls right next to the D (bunker). (This is not a Cartesian graph.) The printer width is the altitude and the + s actually are seconds in time. The 40 in line number 220 is my printer width and can be changed for

```
NO. 0
YOUR CANNON HAS A MUZZLE
VELOCITY (FT/SEC) OF 2318
AND YOU ARE AIMING AT A TARGET
X FEET AWAY. X = 30902
AT WHAT ELEVATION OR UPWARD
ANGLE WILL YOU NEED TO RAISE
THE BARREL TO HIT IT?

NO. 0
TIME IN AIR = 13.3886158 SECS
MAX. HEIGHT =- 717.020137 FT
RANGE = 30902 FT
TRUE ANGLE = 5.30255255


NO. 0
YOUR CANNON HAS A MUZZLE
VELOCITY (FT/SEC) OF 2270
AND YOU HAVE YOUR CANNON ANGLED
UP AT 43 DEGREES.  HOW FAR WILL
THE SHELL GO

NO. 0
TIME IN AIR = 96.7585225 SECS
MAX. HEIGHT = 37448.8464 FT
RANGE = 160635 FT
TRUE ANGLE = 0
```

Example 3. Artillery sample run; angle problem and distance problem.

Program 3. Artillery.

```
0004 PRINT
0005 PRINT "ARTILLERY":PRINT
0010 PRINT "TIME,HT. AND RANGE ARE FOR"
0011 PRINT "ENTERED VALUES. TRUE ANGLE IS"
0012 PRINT "TO HIT TARGET."
0030 INPUT "GAME(1),ANGLE PROBLEM PRINTER(2) OR DISTANCE PROBLEM(3)",Q
0031 PRINT CHR$(16),CHR$(22)
0032 IF Q=1 THEN 115
0033 INPUT "NO. OF STUDENTS ",Z
0034 PRINT CHR$(16),CHR$(22)
0035 IF Q<>1 THEN PORT=7
0036 GOTO 115
0101 LET T=(2*(V*SIN(E)))/32)
0103 PRINT :PRINT"NO. ";J;:PRINT:PRINT"TIME IN AIR = ";T;"SECS"
0104 LET D1=((V*SIN(E))*(V*SIN(E))/64)
0105 PRINT "MAX. HEIGHT = ";D1;" FT":PRINT"RANGE = ";R;" FT"
0110 LET G=(D*32)/(V*V):IFG>1 THEN PRINT"TRY AGAIN":GOTO114
0111 LET J=J+1: LET W=((ATAN(G/SQR(1-G*G)))/2)*57.29578
0112 PRINT "TRUE ANGLE = ";W: IF J=Z THEN 360
0113 GOTO 115
0114 IF Q<>1THEN188
0115 PRINT "-------------":PRINT:PRINT:PRINT"NO. ";J
0116 PRINT "YOUR CANNON HAS A MUZZLE"
0130 PRINT "VELOCITY (FT/SEC) OF ";:IFQ<>1THEN132
0131 INPUT V:GOTO140
0132 LET V=INT(1600+RND(0)+800)
0133 PRINT V:IFQ<3THEN140
0134 IF Q=3THENW=INT(RND(0)*80)+1:PRINT"AND YOU HAVE YOUR CANNON ANGLED "
0135 PRINT "UP AT ";W;" DEGREES.  HOW FAR WILL THE SHELL GO?"
0136 IF Q<3THEN140
0137 LET E=W:GOTO210
0140 PRINT "AND YOU ARE AIMING AT A TARGET"
0150 PRINT "X FEET AWAY. X = ";:IFQ<>1THEN153
0151 INPUT D:GOTO160
0153 LET D=INT(30000*RND(0)+9000)
0154 PRINT D
0160 PRINT "AT WHAT ELEVATION OR UPWARD"
0170 PRINT "ANGLE WILL YOU NEED TO RAISE"
0180 PRINT "THE BARREL TO HIT IT?"
0181 IF Q<> 1 THEN 188
0182 INPUT E:GOTO200
0188 LET G=(D*32)/(V*V)
0189 IF G>1THEN115
0190 LET E=((ATAN(G/SQR(1-G*G)))/2)*57.29578
0200 IF E=90 THEN 330
0210 LET E=E/57.29578
0220 LET R=2*(V*COS(E))*(V*SIN(E))/32
0230 LET R=INT(R)
0236 IF Q=1THEN240
0238 IF Q<>1THEN101
0240 IF ABS(R-D)/D<.0005THEN PRINT"BULLSEYE !!! *  DIRECT HIT !!"
0241 LET W=ABS(R-D)
0242 LET S=(W/D)*100
0243 IF S<5THEN246
0244 PRINT CHR$(7)
0245 GOTO 247
0246 PRINT "VERY GOOD !!"
0247 REM BELL=GONG,"GOOD"=HIT
0248 LET X=R-D:IFABS(R-D)/D<.0005THEN101
0249 LET Y=D-R
0250 IF R>D THEN 290
0260 IF R<D THEN 310
0290 PRINT "OVERSHOT BY ";X;" FEET"
0300 GOTO 101
0310 PRINT "FELL SHORT BY ";Y;" FEET"
0320 GOTO 101
0330 PRINT "I CERTAINLY WOULDN'T DO THAT"
0340 PRINT "IF I WERE YOU!!!  ELEVATION?"
0350 GOTO 182
0360 PORT= 1
0370 END
```

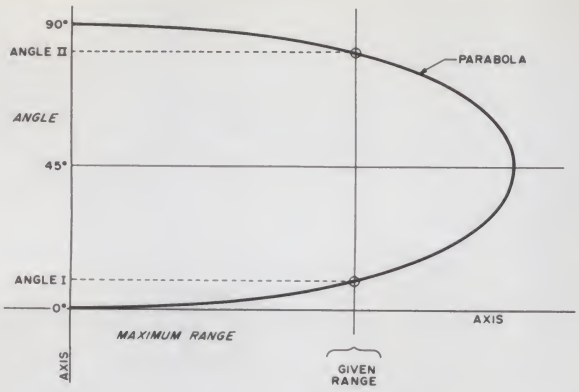


Fig. 2. Graph showing two angles required for same range from cannon.

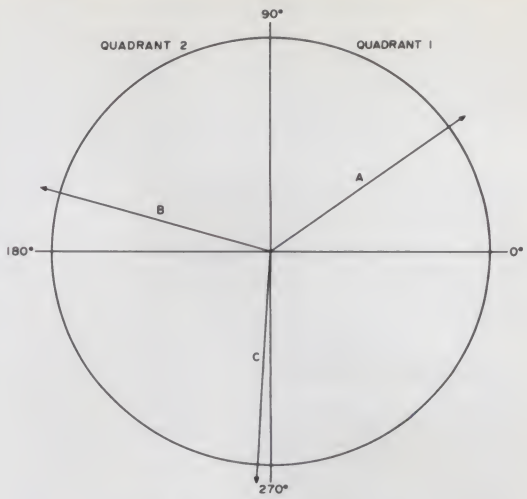


Fig. 3. Sample Vector diagram.

any other printer.

Artillery

Artillery (Program 3) runs in four modes. Again the plot mode is another program. It can produce individual problems for every student, be played as a game, output one test question or plot a shell's path. (Some combination of variables will not allow the target to be hit. In these cases a new question is automatically generated with the answers.)

The muzzle velocity and the angle of fire are the variables. Giving the muzzle velocity and angle and asking for the range, time in the air and maximum height is a straightforward problem, if somewhat tedious. Giving the muzzle velocity and distance to the target and asking what angle will be required to hit the target is much more complex because a trig identity is required (see Example 3). Two angles will give the same range, except for 45 degrees. See Fig. 2. When the student enters values for the time in the air, maximum height and range of the shell, the angle printed out is the angle that will hit the target (low angle). Artillerymen have long known of the two firing angles called the lob (high) and the point blank (low). The lob was rarely used except for over fort walls.

If the time in the air for the correctly aimed cannon is required, then change line 190 to LET E = ((ATAN(G/SQR(1 – G*G))))/2)*57.29578 and add 188 LET G = (D*32)/(V*V).

Artillery Plot

This program (Program 3a) asks for the student's name, the muzzle velocity and the angle of fire. The + goes up to the full height (printer width) and should fall on the D. (This is not a Cartesian graph.) Each + is one second. The 40 in line 230 is my printer width. There is no error report and no bell sounds.

Vectors

Vectors (Program 4) has three modes and calculates the force needed to create equilibrium with two other forces. Force A is in the first quadrant (0 to 90 degrees) and force B is in the second quadrant (90 to 180 degrees). Force C could be in the third or fourth quadrant, depending on forces A and B. See the diagram in Fig. 3.

When running in the individual-problem mode, the correct answer is output right after the problem (see Example 4). I cut

```
0100 PRINT "ARTILLERY PLOT-ENTER DISTANCE."
0120 PRINT "VELOCITY AND ELEVATION ANGLE"
0130 PRINT "(FEET, FT/SEC, DEGREES)"
0140 INPUT D,V,E
0145 INPUT "NAME ", N$
0147 LET E=E/57.29578
0150 LET T1=(2*(V*SIN(E)))/32
0160 PORT= 7
0165 PRINT N$:PRINT:PRINT
0180 LET H=((V*SIN(E)*V*SIN(E))/64)
0200 G=(D*32)/(V*V)
0210 A=((ATAN(G/SQR(1-G*G)))/2)
0215 T2=D/(V*COS(A))
0220 LET Y=(V*SIN(E)*T)-(16*T*T)
0225 REM : 40 IS WIDTH OF PRINTER(PR-40)
0230 LET Y=Y/(H/40)
0235 IF Y<0THEN310
0236 IF T1=9999THEN240
0238 IF T>T2THEN PRINT"D"::LETT1=9999
0240 PRINT TAB(INT(Y));"+"
0260 LET T=T+1
0300 GOTO 220
0310 IF T>T2THEN370
0330 LET T=T+1
0340 IF T>T2THEN370
0350 PRINT
0360 GOTO 330
0370 IF T1<>9999THEN PRINT"D"
0380 PORT= 1
```

Program 3a. Artillery plotter program.

Program 4. Vectors.

```
0010 PRINT "VECTORS"
0020 PRINT "GAME(1), TEST QUESTION(2)"
0030 PRINT "OR CONTINUOUS PRINTER(3)"
0040 INPUT P
0041 LET Z9=1
0090 IF P=3THENPRINT#7;"**********************"
0100 IF P=3THENA1=((RND(0)*1000)+100):A=((RND(0)*89)+1):GOTO141
0105 PRINT CHR$(16),CHR$(22)
0110 PRINT "INPUT VECTOR 'A' IN THE FORM"
0120 PRINT "MAGNITUDE, ANGLE (360') IN"
0130 PRINT "THE FIRST QUADRANT";
0140 INPUT A1,A
0141 IF P=3THENA1=INT(A1):A=INT(A)
0142 PRINT #7;"PROBLEM #";Z9
0145 PRINT #7;"MAGN(A)= ";A1;" ,ANGLE(A)=";A
0146 IF P=3THENB1=((RND(0)*1000)+100):B=((RND(0)*89)+91):GOTO161
0150 PRINT "INPUT VECTOR 'B', QUADRANT 2"
0160 INPUT B1,B
0161 IF P=3THENB1=INT(B1):B=INT(B)
0165 PRINT #7;"MAGN(B)= ";B1;" ,ANGLE(B)=";B
0170 IF P>1THEN210
0180 PRINT "WHAT VECTOR, 'C', WILL CREATE"
0190 PRINT "EQUILIBRIUM ";
0200 INPUT D1,D
0210 LET A=A/57.29578
0220 LET B=B/57.29578
0230 LET D=D/57.29578
0240 LET A2=A1*COS(A)
0250 LET A3=A1*SIN(A)
0260 LET B2=B1*COS(3.141592654-B)
0270 LET B3=B1*SIN(3.141592654-B)
0280 LET C3=A3+B3
0285 LET C2 =0
0290 IF A2=B2 THEN 385
0300 IF B2>A2 THEN 340
0310 LET C2=A2-B2
0320 GOTO 350
0340 LET C2=B2-A2
0350 LET X=C2/C3
0355 LET S=ATAN(X)
0360 IF A2>B2 THEN 375
0365 LET C=4.712389+S
0370 GOTO 390
0375 LET C=4.712389-S
0380 GOTO 390
0385 LET C=4.712389
0390 IF D>C THEN 430
0400 IF C>D THEN 450
0410 LET E=0
0420 GOTO 460
0430 LET E=D-C
```

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```
0440 GOTO 460
0450 LET E=C-D
0460 LET C1=SQR((C2*C2)+(C3*C3))
0470 LET F=SQR((D1*D1)+(C1*C1)-((2*C1*D1)*COS(E)))
0476 LET J=(F/C1)*100
0477 IF P>1 THEN 482
0480 PRINT "OFF BY ";F;" UNITS !"
0482 LET Q=C*57.29578
0483 PRINT #7:PRINT#7:PRINT#7;"-----------------":PRINT#7:PRINT#7
0484 PRINT "TRUE MAGN.=";C1;", ANGLE=";Q:PRINT#7;"PROBLEM #";Z9
0485 PRINT #7;"MAGN(C)= ";C1;", ANGLE(C)=";Q:IFP=1THEN550
0486 IF P>1THEN490
0487 PRINT "ENTER 1 FOR NEXT TRY, 2 FOR     COMPONENTS ";
0488 INPUT K:IF K=1 THEN 105
0489 PRINT CHR$(16),CHR$(22)
0490 PRINT "A1=";INT(A1);"   A2=";INT(A2);"   A3=";INT(A3)
0491 PRINT #7;"A1=";A1;"  A2=";A2;"  A3=";A3
0495 PRINT "B1=";INT(B1);"   B2=";INT(B2);"   B3=";INT(B3)
0500 PRINT #7;"B1=";B1;"  B2=";B2;"  B3=";B3
0505 PRINT "C1=";INT(C1);"   C2=";INT(C2);"   C3=";INT(C3)
0508 PRINT #7;"C1=";C1;"  C2=";C2;"  C3=";C3
0510 LET Z9=Z9+1
0511 PRINT
0512 PRINT "(SUBSCRIPT  2  INDICATES HORIZ,"
0513 PRINT "(3  INDICATES VERTICAL)"
0514 PRINT #7;"SUB 2=HORIZ, SUB 3=VERT"
0515 PRINT
0518 IF P=3THEN90
0520 PRINT "PRINT 1 FOR NEXT TRIAL ";
0530 INPUT X
0540 IF X=1 THEN 105
0550 IF J<5 THEN 570
0560 PRINT CHR$(7)
0568 GOTO 486
0570 PRINT "VERY GOOD !!"
0585 GOTO 486
0590 END
```

these off and staple them in ascending order. When the student has answered his question either you or the computer can tell him if it is correct. The components of the vectors are output with the answer to help the student see where the error was made.

Kentucky Moonshine Runner

Kentucky Moonshine Runner (Program 5) simulates a high-speed moonshine runner heading for the border being chased by a police car that takes off after him the moment the runner is even with the cruiser. The policeman must catch the bootlegger with 500 feet left to come to a stop. If he accelerates 4 percent too fast he will blow his engine. The speed of the runner and the distance to the border are randomly selected and the student must enter the acceleration (see Example 5). There is a 150-foot leeway that will count as a catch if the police go past the border.

This program can print out individual problems for each student and later be used to check the answers, or you can use it to generate a test item or as a video display.

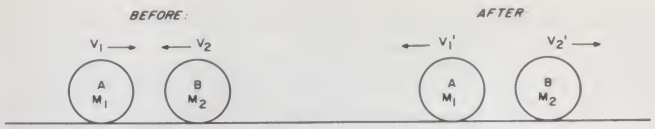


Fig. 4. Collisions.

Collisions

Collisions (Program 6) simulates the elastic (no energy wasted) rebounding between two steel balls travelling at different speeds and having different masses (Fig. 4). It will calculate the velocities and directions after the collisions (see Example 6). One can be stationary, and they are assumed to have the same diameter. All variables are input. There is no friction and rolling inertia is disregarded. They can have the same mass.

Cycle Skid

Cycle Skid (Program 7) simulates a cyclist (cycle, bike or car) rounding a curve (see Fig. 5). The program has two modes; printer output or video. Given a velocity, a certain coefficient of friction (tires) and the acceleration of gravity, the cyclist can only take a certain radius turn. This program calculates this minimum radius turn. The amount of lean can also be calculated, as well as the "G" force acting on the rider. The program can generate its own variables or you can enter your own.

```
VECTORS
PROBLEM #1
MAGN(A)= 350  ,ANGLE(A)=34
MAGN(B)= 750  ,ANGLE(B)=142

PROBLEM #1
MAGN(C)9=723.0256 , ANGLE(C)=294.588063

A1=350   A2=290.16316   A3=195.717515
B1=750   B2=591.008025   B3=461.746125
C1=723.0256   C2=300.844865   C3=657.46364
```

Example 4. Sample run of Vector.

```
NO. 0
KENTUCKY MOON RUNNER IS HITTING
125  MPH (183  FT/SEC)
TRYING TO GET TO THE BOARDER
7 MILES AWAY (36960 FEET)
HOW FAST WILL COUNTIE MOUNTIE
HAVE TO ACCELERATE (FT/SEC/SEC)
TO JUST GET HIM WITH 500 FEET
LEFT TO COME TO A STOP?
NO. 0
TRUE ACCEL. = 1.83702687
```

Example 5. Kentucky Moonshine run.

```
0005 PRINT "150 FT LEEWAY, 4% TOO MUCH ACC--"
0006 PRINT "ELERATION BLOWS ENGINE"
0010 PRINT "RANDOM PRINTOUT OF PROBLEMS (1),"
0020 PRINT "ENTERED VARIABLES (2) OR"
0030 PRINT "VIDEO INPUT/OUTPUT (3)";
0040 INPUT P
0050 IF P>1 THEN PRINT "GAME (YES=1)";:INPUT H: GOTO 70
0060 INPUT "HOW MANY PROBLEMS ",K
0070 PRINT CHR$(16),CHR$(22)
0100 IF P<>3THEN PORT=7
0103 PRINT "NO. ";J
0105 PRINT "KENTUCKY MOON RUNNER IS HITTING"
0109 IF P=2THEN117
0110 LET S=INT(50*RND(0)+90)
0116 IF P=1 THEN PORT=7:GOTO120
0117 PORT= 1
0118 INPUT "MPH =",S
0119 IF P<>3 THEN PORT=7
0120 LET S1=INT(S*44/30)
0130 PRINT S;" MPH (";S1;" FT/SEC)"
0140 PRINT "TRYING TO GET TO THE BORDER"
0145 IF P=2 THEN 155
0150 LET B=INT(8*RND(0)+1)
0151 IF P=1 THEN PORT=7:GOTO160
0155 PORT= 1
0158 INPUT "MILES TO BORDER =",B
0159 IF P<>3 THEN PORT=7
0160 LET B1 = B*5280
0170 PRINT B;" MILES AWAY (";B1;" FEET)"
0180 PRINT "HOW FAST WILL COUNTY MOUNTIE"
0190 PRINT "HAVE TO ACCELERATE (FT/SEC/SEC)"
0200 PRINT "TO JUST GET HIM WITH 500 FEET"
0210 PRINT "LEFT TO COME TO A STOP?"
0212 IF P=2 THEN 216
0215 IF P=1 THEN PORT=7:GOTO221
0216 PORT= 1
0218 INPUT "ACCEL. =",A
0219 IF P<>3THEN PORT=7
0220 PRINT A
0221 PRINT :PRINT:PRINT"NO. ";J
0222 LET A1=2*S1*S1/(B1-500)
0223 LET J=J+1
0224 PRINT "TRUE ACCEL. = ";A1
0225 IF H<>1 THEN 375
0230 LET D1=2*S1*S1/A
0235 LET X=INT(D1+500-B1)
0238 LET Y=INT(B1-500-D1)
0250 IF D1>INT(B1-500) THEN 290
0260 IF D1<INT(B1-500) THEN310
0270 PRINT "PERFECT, JUST IN TIME!!"
0280 GOTO 375
0290 PRINT "HE GOT AWAY BY ";X;" FEET!"
0292 IF X>150 THENPRINTCHR$(7):GOTO375
0294 PRINT "GOOD ENOUGH !!"
0300 GOTO 375
0310 PRINT "CAUGHT WITH ";Y;" FT. LEFT!"
0311 IF Y>150 THEN PRINTCHR$(7)
0318 IF A/A1<1.04THENPRINT"GOOD ENOUGH !!":GOTO375
0320 PRINT "BUT YOU BLEW UP YOUR ENGINE"
0330 PRINT "JUST AS YOU GOT TO HIM AND HE"
0340 PRINT "TOOK OFF AGAIN ! !"
0375 PRINT :PRINT:PRINT"----------"
0376 PORT= 1
0378 IF J=K THEN 390
0380 GOTO 70
0390 END
```

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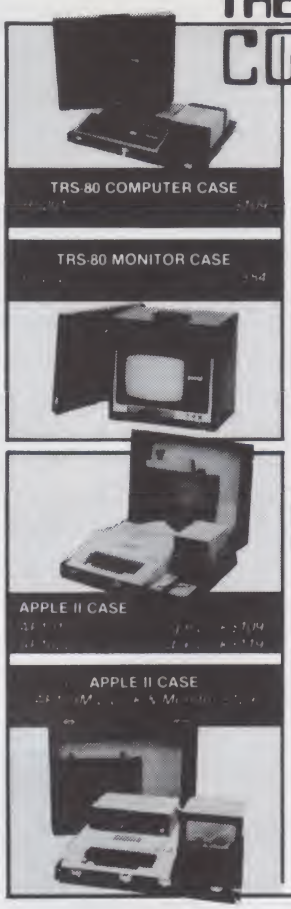
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B J E L F E Q A Z G Z P P C R Y P T O U P Z A X Z Q J E J T S
Z D Q I N K F S N A G T H L G F J S E Y W T V N P F J V Z V C
B V L F G U L M N S N E K O T T S C Y M B C G W B Q O F M P O
U O V Z K B F I O E P U Y A S E X M O L E R Z J X A C H Y R U
P K B M Y U C W O C G L D M R X S E W M C Z T I O N G U L Y K
Z M H O U P X B L K A C A P J J U K B F L I P C N E F Q A F E
J W T A Y C J G W H E T M N H A Q Z Q J L O W E R C A S E T H
H R S S K V C D G C B O A P T G T H T X T P M L E I L R E T Q
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```
0001 PRINT "RANDOM (1) OR INPUTS (2)":INPUTZ:IFZ=1THEN10:PRINT
0002 PRINT "+ MEANS TO RIGHT":PRINT"ENTER MASS & VELOCITY OF 'A'"
0003 INPUT M1,V1:PRINT#7;"'A' : MASS = ";M1;" ,VEL. = ";V1
0004 PRINT "INPUT MASS & VELOCITY OF 'B'"
0005 INPUT M2,V2:PRINT#7;"'B' : MASS = ";M2;" ,VEL. = ";V2
0006 GOTO 160
0010 PRINT "HOW MANY PROBLEMS ";:INPUT N
0011 PRINT #7;"NO. ";J
0015 PRINT
0020 LET M1=INT(8*RND(0)+1)
0030 LET M2=INT(8*RND(0)+1)
0040 LET V1=INT(6*RND(0)+1)
0050 LET V2=INT(6*RND(0)+1)*(-1)
0060 PRINT "BALL A GOING ";V1;"FT/SEC TO RT."
0065 PRINT #7;"BALL 'A' GOING ";V1;" FT/SEC TO RT."
0070 PRINT "WITH MASS ";M1;"HITS BALL B WITH M="
0075 PRINT #7;"WITH MASS ";M1;" HITS BALL 'B' WITH M="
0080 PRINT M2;" GOING ";V2;" FT/SEC TO THE LEFT"
0085 PRINT #7;M2;" GOING ";V2;" FT/SEC TO THE LEFT"
0090 PRINT "WHAT WILL BE THE FINAL VELOCITY"
0095 PRINT #7;"WHAT WILL BE THE FINAL VELOCITY"
0100 PRINT "AND DIRECTION OF EACH BALL ?"
0105 PRINT #7;"AND DIRECTION OF EACH BALL ?"
0110 PRINT "(+ MEANS TO RIGHT, - TO LEFT)"
0111 PRINT #7;"(+ MEANS TO RIGHT, - TO LEFT)"
0112 PRINT
0113 PRINT #7:PRINT#7
0114 PRINT
0115 PRINT J
0116 PRINT #7;"NO. ";J
0117 GOTO 160
0120 PRINT "BALL A = ";
0130 INPUT V3
0135 PRINT #7;"BALL A = ";V3
0140 PRINT "BALL B = ";
0150 INPUT V4
0155 PRINT #7;"BALL B= ";V4
0160 LET V1=V1-V2
0180 LET V5=((M1-M2)/(M1+M2))*V1
0190 LET V6=((2*M1/(M1+M2))*V1
0200 LET V5=V5+V2
0210 LET V6=V6+V2
0220 PRINT "VELOC. OF BALL 'A' = ";V5
0225 PRINT #7;"VELOC. OF BALL 'A' = ";V5
0230 PRINT "VELOC. OF BALL 'B' = ";V6
0235 PRINT #7;"VELOC. OF BALL 'B' = ";V6
0238 IF Z=1 THEN 253
0240 PRINT "AGAIN (YES=1) ";
0250 INPUT Q
0251 IF Q<>1 THEN 300
0253 PRINT #7:PRINT#7
0255 LET J=J+1
0258 IF J=N THEN 300
0270 IF Z=1 THEN 11
0280 GOTO 2
0300 END
```

Program 6. Collisions.

```
NO. 0
BALL 'A' GOING 6 FT/SEC TO RT.
WITH MASS 7  HITS BALL 'B' WITH M=2
GOING -2 FT/SEC TO THE LEFT
WHAT WILL BE THE FINAL VELOCITY
AND DIRECTION OF EACH BALL?
(+ MEANS TO RIGHT, - TO LEFT)

NO. 0
VELOC. OF BALL 'A' = 2.44444444
VELOC. OF BALL 'B' = 10.4444444
```

Example 6. Collisions sample run.

```
CYCLE SKID PROBLEM
NO. 0
COEFF. OF FRICTION = 0.8
VELOCITY = 19  METERS/SEC
'G' = 9.8 M/SEC

NO. 0
TIGHTEST RADIUS CURVE = 46.0459183
'G'-FORCE = 1.28062448
ANGLE OF LEAN = 38.6597946 DEGREES
```

Example 7. Sample run of Cycle Skid.

```
0001 PRINT "CYCLE SKID PROBLEM"
0002 PRINT "PRINTOUT (1) OR VIDEO (2)";:INPUT P
0005 PRINT #7;"CYCLE SKID PROBLEM"
0011 PRINT "RANDOM (1) OR INPUTS (2)"
0012 INPUT Z
0013 IF P=1THENPORT=7
0014 IF Z=1THEN70
0020 PRINT #1;"ENTER COEFFICIENT OF FRICTION";
0025 INPUT #1,U
0028 PRINT #7;"COEFF. OF FRICTION=";U
0036 PRINT #1;"ENTER VELOCITY ";
0038 INPUT #1,V
0039 PRINT #7;"VELOCITY = ";V
0041 PRINT #1;"ENTER ACCEL. OF GRAVITY ";
0042 INPUT #1,G:PRINT#7;"G = ";G
0043 LET R=(V*V)/(U*G)
0045 PRINT "TIGHTEST RADIUS CURVE = ";R
0050 LET F=SQR((G*G)+(((V*V)/R)*((V*V)/R)))
0055 LET F1=F/G
0060 PRINT "'G'-FORCE = ";F1
0065 LET A=((V*V)/(R*G))
0068 PRINT "ANGLE OF LEAN = ";ATAN(A)*57.29578;" DEGREES"
0069 PRINT #1;"TYPE A DIGIT";:INPUT#1,Q:PRINT#7:PRINT#7:PRINT#7:IFZ=2THEN20
0070 LET U=(INT(9*RND(0)+1)/10)
0072 PRINT "NO. ";J
0075 PRINT "COEFF. OF FRICTION = ";U
0080 LET V=INT(25*RND(0)+5)
0085 PRINT "VELOCITY = ";V;" METERS/SEC"
0090 LET G=9.8
0100 PRINT "'G' = 9.8 M/SEC"
0105 PRINT :PRINT:PRINT:PRINT"NO. ";J
0108 LET J=J+1
0110 IF Z=2THEN20
0120 GOTO 43
```

Program 7. Cycle Skid.

The lean is a function of weight and centrifugal force (actually centripetal force). Gravity in the meter-kg-sec system is 9.8 m/s/s and is 32 ft/s/s in the English. (See Example 7.) Incidentally, the tangent of the angle of lean for the tightest radius curve equals the coefficient of friction. A good coefficient is .8 for tire rubber on dry asphalt. The angle of lean would also be the steepest bank the cyclist could maintain while being vertical himself.

All units must be compatible and most users will use English units throughout. Speed must be ft/s. For any other planet the acceleration of gravity would be different. On the moon g would equal 1.6.

Thermal

Thermal (Program 8) is a long-winded program to determine the final temperature of objects placed in contact with water, ice or steam (see Fig. 6). The heat lost by the hot object equals the heat gained by the cold object. To melt ice requires 80 cal/gram; to produce steam requires 540 cal/gram. And the opposite holds true—as water vapor condenses it gives off 540 cal/gram (so cover your soft drink if you want it to keep cold). Freezing ice absorbs 80 cal/gram.

The amount of heat stored in an object is a product of its mass and specific heat, which is a comparison of the object's heat-storage capacity to that of water (a good storage medium).

There are 11 different cases in the program. Actually, the mass, specific heats and temperatures are input for components, except the mass of one item (even

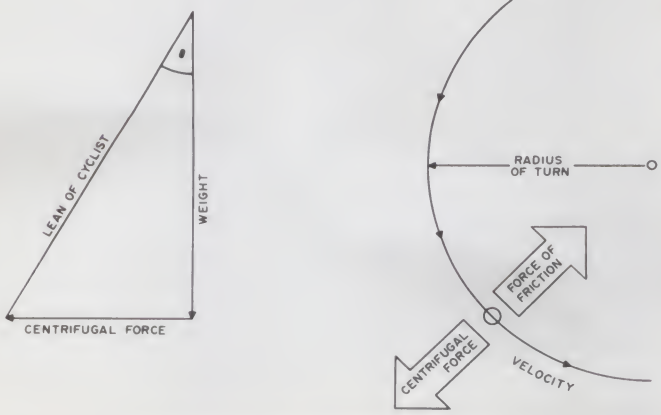


Fig. 5. Forces on cyclist taking curve.

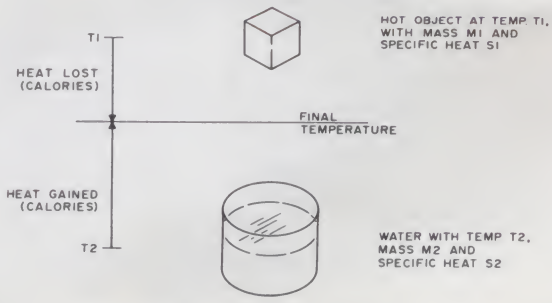


Fig. 6. Thermal equilibrium.

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```
0001 PORT= 7:PRINT"CASE 1 IS WARM OBJECT INTO COOL WATER":PRINT
0002 PRINT "CASE 2 IS WARM OBJECT INTO ICE, FINAL     TEMP. >0C":PRINT
0003 PRINT "CASE 3 IS WARM OBJECT INTO ICE, FINAL     TEMP. < 0C":PRINT
0004 PRINT "CASE 4 IS HOT (>100C) OBJECT INTO ICE,    FINAL TEMP = 100C";
0005 PRINT ", ALL WATER TURNS TO STEAM":PRINT
0006 PRINT "CASE 5 IS SAME AS 4 BUT NO WATER TURNS    TO STEAM":PRINT
0007 PRINT "CASE 6 IS HOT (>100C) OBJECT INTO ICE    WITH FINAL TEMP. 0";
0008 PRINT "C WITH ALL ICE MELTED":PRINT
0009 PRINT "CASE 7 IS SAME AS 6 WITH NO ICE MELTED":PRINT
0010 PRINT "CASE 8 IS STEAM INTO WATER WITH FINAL     TEMP. < 100C": PRINT
0011 PRINT "CASE 9 IS WARM OBJECT INTO COOL WATER IN CALORIMETER":PRINT
0012 PRINT "CASE 10 IS ICE INTO WATER IN CALORIMETER, FINAL TEMP. >0C"
0013 PRINT :PRINT"CASE 11 IS STEAM INTO WATER AND ICE IN    CAL., FINAL ";
0014 PRINT "TEMP. IS >0 AND <100C":PRINT
0015 PORT= 1:PRINT"THERMAL EQUILIBRIUM"
0020 PRINT
0030 PRINT "ENTER CASE NUMBER (1-11)"
0035 PRINT "-INTEGERS ONLY-"
0040 INPUT C
0045 PRINT #7;"CASE ";C
0050 ON C GOTO 100,200,300,400,500,600,700,800,900,1000,1100
0065 PRINT "CASES 1 THRU 11 ONLY"
0070 GOTO 20
0100 PRINT "ENTER TEMP. HOT OBJECT ";
0105 INPUT T1
0108 PRINT #7;"TEMP. HOT OBJECT = ";T1
0110 PRINT "ENTER MASS OF HOT OBJECT ";
0115 INPUT M1
0118 PRINT #7;" MASS OF HOT OBJECT = ";M1
0120 PRINT "ENTER SPEC. HT. OF OBJECT ";
0125 INPUT S1
0128 PRINT #7;"SPEC. HT. HOT OBJECT =";S1
0130 PRINT "ENTER TEMP. OF COLD WATER ";
0135 INPUT T2
0138 PRINT #7;"TEMP. COLD WATER ="; T2
0140 PRINT "ENTER FINAL TEMP. ";
0145 INPUT T3
0148 PRINT #7;"FINAL TEMP. = ";T3
0150 LET X=((T1-T3)*S1*M1)/(T3-T2)
0160 PRINT "MASS OF COLD WATER = ";X
0163 PRINT #7;"MASS OF COLD WATER =";X
0165 GOTO 20
0200 PRINT "ENTER TEMP. OF HOT OBJECT ";
0210 INPUT T1
0215 PRINT #7;"TEMP. OF HOT OBJECT = ";T1
0220 PRINT "ENTER MASS OF HOT OBJECT ";
0225 INPUT M1
0228 PRINT #7;"MASS OF HOT OBJECT =";M1
0230 PRINT "ENTER SPEC. HT. OF OBJECT ";
0235 INPUT S1
0238 PRINT #7;"SPEC. HT. OF HOT OBJECT =";S1
0240 PRINT "ENTER TEMP. OF ICE ";
0245 INPUT T2
0248 PRINT #7;"TEMP. OF ICE =";T2
0250 PRINT "ENTER FINAL TEMPERATURE ";
0255 INPUT T3
0259 PRINT #7;"FINAL TEMP. =";T3
0260 LET X=((T1-T3)*S1*M1)/(80+T3-(.5*T2))
0265 PRINT "MASS OF ICE = ";X
0268 PRINT #7;"MASS OF ICE =";X
0270 GOTO 20
0300 PRINT "ENTER TEMP. OF HOT OBJECT ";
0310 INPUT T1
0315 PRINT #7;"TEMP. HOT OBJECT =";T1
0320 PRINT "ENTER MASS OF HOT OBJECT ";
0330 INPUT M1
0335 PRINT #7;"MASS OF OBJECT =";M1
0340 PRINT "ENTER SPEC. HT. OF OBJECT ";
0350 INPUT S1
0355 PRINT #7;"SPEC. HT. OF OBJECT =";S1
0360 PRINT "ENTER TEMP. OF ICE ";
0370 INPUT T2
0375 PRINT #7;"TEMP. OF ICE =";T2
0380 PRINT "ENTER FINAL TEMP. ";
0381 INPUT T3:PRINT#7;"FINAL TEMP. =";T3
0382 LET X=((T1-T3)*S1*M1)/((T3-T2)*.5)
0384 PRINT "MASS OF ICE = ";X
0385 PRINT #7;"MASS OF ICE =";X:GOTO20
0400 PRINT "ENTER TEMP. OF HOT OBJECT ";
0404 INPUT T1
0405 PRINT #7;"TEMP. OF HOT OBJECT =";T1
0406 PRINT "ENTER MASS OF HOT OBJECT ";
0410 INPUT M1
0413 PRINT #7;"MASS OF HOT OBJECT =";M1
0415 PRINT "ENTER SPEC. HT. OF OBJECT ";
0420 INPUT S1
0425 PRINT #7;"SPEC. HT. OF OBJECT =";S1
0430 PRINT "ENTER TEMP. OF ICE ";
0435 INPUT T2
0438 PRINT #7;"TEMP. OF ICE =";T2
0440 LET X=((T1-100)*M1*S1)/(720-(T2*.5))
0445 PRINT "MASS OF ICE = ";X
0448 PRINT #7;"MASS OF ICE =";X
0450 GOTO 20
0500 PRINT "ENTER TEMP. OF HOT OBJECT ";
0505 INPUT T1
0508 PRINT #7;"TEMP. OF HOT OBJECT =";T1
0510 PRINT "ENTER MASS OF HOT OBJECT ";
0515 INPUT M1
0518 PRINT #7;"MASS OF HOT OBJECT =";M1
0520 PRINT "ENTER SPEC. HT. OF OBJECT ";
0525 INPUT S1
0528 PRINT #7;"SPEC. HT. OF OBJECT =";S1
0530 PRINT "ENTER TEMP. OF ICE ";
0535 INPUT T2
0538 PRINT #7;"TEMP. OF ICE =";T2
0540 LET X=((T1-100)*M1*S1)/(180-(T2*.5))
0545 PRINT "MASS OF ICE = ";X
0548 PRINT #7;"MASS OF ICE =";X
0550 GOTO 20
0600 PRINT "ENTER TEMP. OF HOT OBJECT ";
0605 INPUT T1
0608 PRINT #7;"TEMP. OF HOT OBJECT =";T1
0610 PRINT "ENTER MASS OF HOT OBJECT ";
0615 INPUT M1
0618 PRINT #7;"MASS OF HOT OBJECT =";M1
0620 PRINT "ENTER SPEC. HT. OF OBJECT ";
0625 INPUT S1
0628 PRINT #7;"SPEC. HT. OF OBJECT =";S1
0630 PRINT "ENTER TEMP. OF ICE ";
0635 INPUT T2
0638 PRINT #7;"TEMP. OF ICE =";T2
0640 LET X=(T1*M1*S1)/(80-(T2*.5))
0645 PRINT "MASS OF ICE = ";X
0648 PRINT #7;"MASS OF ICE= ";X
0650 GOTO 20
0700 PRINT "ENTER TEMP. OF HOT OBJECT ";
0705 INPUT T1
0708 PRINT #7;"TEMP. OF HOT OBJECT =";T1
0710 PRINT "ENTER MASS OF HOT OBJECT ";
0715 INPUT M1
0718 PRINT #7;"MASS OF HOT OBJECT= ";M1
0720 PRINT "ENTER SPEC. HT. OF OBJECT ";
0725 INPUT S1
0728 PRINT #7;"SPEC. HT. OF HOT OBJECT =";S1
0730 PRINT "ENTER TEMP. OF ICE ";
0735 INPUT T2
0738 PRINT #7;"TEMP. OF ICE =";T2
0740 LET X=(T1*M1*S1)/((ABS(T2))*.5)
0745 PRINT "MASS OF ICE = ";X
0748 PRINT #7;"MASS OF ICE = ";X
0750 GOTO 20
0800 PRINT "ENTER TEMP. OF WATER ";
0805 INPUT T2
0808 PRINT #7;"TEMP. OF WATER =";T2
0810 PRINT "ENTER MASS OF WATER ";
0815 ;T3
0830 LET X=((T3-T2)*M2)/(540+(100-T3))
0835 PRINT "MASS OF STEAM = ";X
0838 PRINT #7;"MASS OF STEAM = ";X
0840 GOTO 20
0900 PRINT "ENTER TEMP. OF HOT OBJECT ";
0902 INPUT T1
0903 PRINT #7;"TEMP. OF HOT OBJECT = ";T1
0904 PRINT "ENTER MASS OF HOT OBJECT ";
0906 INPUT M1
0908 PRINT #7;"MASS OF HOT OBJECT = ";M1
0910 PRINT "ENTER SPEC. HT. OF OBJECT ";
0914 INPUT S1
0916 PRINT #7;"SPEC. HT. OF HOT OBJECT = ";S1
0918 PRINT "ENTER TEMP. OF WATER & CAL.";
0920 INPUT T2
0922 PRINT #7;"TEMP. OF WATER & CAL. = ";T2
0924 PRINT "ENTER MASS OF CALORIM.";
0926 INPUT M3
0927 PRINT #7;"MASS OF CAL. = ";M3
0928 PRINT "ENTER SPEC. HT. OF CAL.";
0930 INPUT S3
0932 PRINT #7;"SPEC. HT. OF CAL. = ";S3
0934 PRINT "ENTER FINAL TEMP.";
0935 INPUT T3
0938 PRINT #7;"FINAL TEMP. = ";T3
0940 LET X=((M1*(T1-T3)*S1)-(M3*S3*(T3-T2)))/(T3-T2)
0945 PRINT "MASS OF WATER = ";X
0948 PRINT #7;"MASS OF WATER = ";X
0950 GOTO 20
1000 PRINT "ENTER TEMP. OF WATER & CAL.";
1005 INPUT T1
1008 PRINT #7;"TEMP. OF WATER & CAL. = ";T1
1010 PRINT "ENTER MASS OF WATER ";
1015 INPUT M1
1018 PRINT #7;"MASS OF WATER = ";M1
1020 PRINT "ENTER MASS OF CALORIM. ";
1025 INPUT M3
1028 PRINT #7;"MASS OF CALORIM. =";M3
1030 PRINT "ENTER SPEC. HT. OF CAL. ";
1035 INPUT S3
1038 PRINT #7;"SPEC. HT. OF CAL. =";S3
1040 PRINT "ENTER TEMP. OF ICE ";
1045 INPUT T2
1048 PRINT #7;"TEMP. OF ICE = ";T2
1050 PRINT "ENTER FINAL TEMPERATURE ";
1060 INPUT T3
1063 PRINT #7;"FINAL TEMP. = ";T3
1065 LET X=((M1*(T1-T3))+(M3*S3*(T1-T3)))/(T3+80-(T2*.5))
1070 PRINT "MASS OF ICE = ";X
1074 PRINT #7;"MASS OF ICE = ";X
1075 GOTO 20
1100 PRINT "ENTER TEMP. OF WATER AND CAL. ";
1105 INPUT T1
1108 PRINT #7;"TEMP. OF WATER & CAL. = ";T1
1110 PRINT "ENTER MASS OF WATER ";
1115 INPUT M1
1118 PRINT #7;"MASS OF WATER = ";M1
1120 PRINT "ENTER MASS OF CAL. ";
1125 INPUT M3
1128 PRINT #7;"MASS OF CAL. = ";M3
1130 PRINT "EPUT M2
1148 PRINT #7;"MASS OF ICE = ";M2
1150 PRINT "ENTER TEMP. OF ICE ";
1155 INPUT T2
1158 PRINT #7;"TEMP. OF ICE = ";T2
1160 PRINT "ENTER FINAL TEMPERATURE ";
1164 INPUT T3
1165 PRINT #7;"FINAL TEMP. = ";T3
1166 LET A=80*M2
1167 LET B=T3*M2
1168 LET C=M1*(T3-T1)
1169 LET D=640-T3
1170 LET X=(A+B+C-(T2*M2*.5)+((T3-T1)*M3*S3))/D
1180 PRINT "MASS OF STEAM = ";X
1185 PRINT #7;"MASS OF STEAM = ";X
1190 GOTO 20
```

```
CASE 3

TEMP.  HOT OBJECT =500

MASS OF OBJECT =12

SPEC.  HT  OF OBJECT =72

TEMP.  OF ICE =-0.89

FINAL TEMP.  =45

MASS OF ICE =17133.1444

CASE 4

TEMP.  OF HOT OBJECT =700

MASS OF HOT OBJECT =34

SPEC.  HT.  OF OBJECT =67

TEMP.  OF ICE =-0.56

MASS OF ICE =1897.59537
```

Example 8. Sample run of Thermal (cases 3 and 4).

Program 8. Thermal.

the final temperature). See Example 8. The program then determines the mass of that one item. Then when the problem is presented to the student, I provide all information except the final temperature, which the student must determine.

Some cases involve an imaginary container, others involve a real one (calorimeter); some go from colder than ice to average temperature, others go from hotter than steam to average. The only restriction is that only grams may be used for mass. Temperature is in Celsius. Specific heat is a ratio, so it is independent of units. All variables are input. Since there's no student input, there is no hit-or-miss report.

```
INCLINED PLANE PROBLEM
LENGTH =12   HEIGHT =7
MASS OR WT. =8 KG
IDEAL FORCE=4.66666666
WORK T TOP=55.99999999
VELOCITY AT BOTTOM=3.741657
FORCE OF FRICTION=1.5
WORK TO TOP W/FRICTION=73.9999999
SPEED AT BOTTOM W/ FRICTION=3.082207
```

Example 10. Inclined Plane sample run.

Pendulum

Program 9 is a good gravity-fall-work type program. A mass on a string swings through an arc while descending distance h. Gravity accelerates it until at the bottom of the swing it is going horizontally and the string breaks. It now is going horizontally as fast as it would have if it just fell distance h, and then it fell distance d to the floor. The horizontal speed does not change. Neither does the work stored in it horizontally. The variables h and d are given as is the mass. The program asks (and answers) how long it will take to hit the floor, how far over it will go and how much work is stored in it. All variables are entered.

Height, h, is measured from any point on the ball, but usually the center of mass. The distance, d, is measured from the bottom since it hits the floor at this point. Time to hit the floor is implied to mean after the string breaks at the bottom of the swing (see Fig. 7).

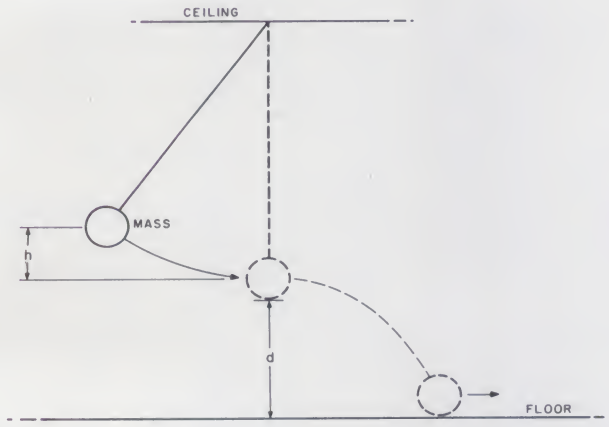


Fig. 7. Diagram for Pendulum. h = height mass falls while tied to string; d = distance to floor.

```
0010 PRINT "PENDULUM SWING"
0015 PRINT #7;"PENDULUM PROBLEM"
0020 PRINT "ENTER HEIGHT, ACCEL. OF"
0030 PRINT "GRAVITY. ";
0040 INPUT H,G
0045 PRINT #7;"HEIGHT=";H;" ,G=";G
0050 LET V=SQR(2*G*H)
0060 PRINT "VELOCITY AT BOTTOM = ";V
0065 PRINT #7;"VEL. AT BOTTOM= ";V
0070 PRINT "ENTER DISTANCE TO FLOOR"
0080 INPUT D
0085 PRINT #7;"DISTANCE TO FLOOR= ";D
0090 PRINT "HORIZ. DISTANCE = ";
0100 LET T=SQR((2*D)/G)
0110 LET D1=V*T
0120 PRINT D1
0125 PRINT #7;"HORIZ. DISTANCE =";D1
0130 PRINT "TIME TO FALL = ";T
0131 PRINT #7;"TIME TO FALL=";T
0132 PRINT "ENTER MASS ";:INPUTM: W=M*G*H
0133 PRINT #7;"MASS=";M
0134 PRINT "WORK TO STOP ROLLING BALL"
0136 PRINT "= ";W
0138 PRINT #7;"WORK TO STOP=";W
0140 END
```

Program 9. Pendulum.

```
PENDULUM PROBLEM
HEIGHT=12   ,G=9.8
VEL.  AT BOTTOM=15. 33623
DISTANCE TO FLOOR= 9
HORIZ. DISTANCE =20. 7846097
TIME TO FALL=1. 355262
MASS=5
WORK TO STOP=588
```

Example 9. Pendulum sample run.

```
0160 PRINT "INCLINED PLANE"
0165 PRINT #7;"INCLINED PLANE PROBLEM"
0170 PRINT "ENTER LENGTH, HEIGHT";
0180 INPUT L,H
0185 PRINT #7;"LENGTH =";L;"  HEIGHT =";H
0190 PRINT "ENTER MASS IN KG OR WT. IN LBS"
0200 PRINT "SUCH AS: 5,KG  -OR-  4,LBS"
0210 INPUT W,S$
0215 PRINT #7;"MASS OR WT. =";W;S$
0220 IF S$="KG" THEN 237
0235 LET M=W/32
0236 GOTO 240
0237 LET M=W
0238 LET W=M*9.8
0240 PRINT " IDEAL FORCE = ";
0250 LET F=(W*H)/L
0260 PRINT F
0265 PRINT #7;"IDEAL FORCE=";F
0270 PRINT "WORK TO TOP = ";:W1=F*L:PRINTW1
0275 PRINT #7;"WORK TO TOP=";W1
0280 PRINT "VEL. AT BOTTOM = ";
0290 LET V=SQR((F*L*2)/M)
0295 PRINT V
0298 PRINT #7;"VELOCITY AT BOTTOM=";V
0300 PRINT "ENTER FORCE OF FRICTION ";
0310 INPUT R
0315 PRINT #7;"FORCE OF FRICTION=";R
0320 LET W1=(F+R)*L
0330 PRINT "WORK TO TOP WITH FRIC. = ";W1
0335 PRINT #7;"WORK TO TOP W/ FRICTION=";W1
0340 LET S=SQR((F-R)*L*2)/M)
0350 PRINT "SPEED AT BOTTOM WITH FRIC.= ";S
0355 PRINT #7;"SPEED AT BOTTOM W/ FRICTION=";S
0360 END
```

Program 10. Inclined Plane.

Inclined Plane

Program 10 simulates the force required to roll a spherical mass up an incline. The length and height of the incline and the mass of the ball are entered. The program prints the ideal force to push or just hold the ball. It will tell you the work it would take to raise the ball to the top and the velocity it would have if the ball rolled to the bottom. (The work would be the same if it were lifted straight up and the velocity would be the same as if it fell straight down.)

Then friction enters the picture. The program prints the work to raise the ball with friction and the velocity it would have at the bottom with friction.

Brake Skid

Brake Skid (Program 11) is a simple, but eye-opening, program that calculates the length of skid marks from a car going a certain speed with a certain type

```
BRAKE SKID PROBLEM
VELO .=88 ,MU=0.7   G=32
SKID DISTANCE=172.857142
```

Example 11. Brake Skid sample run.

```
0370  V=0:G=0:U=0
0371 PRINT #7:PRINT#7:PRINT#7:PRINT#7
0375 PRINT "BRAKE SKID"
0378 PRINT #7;"BRAKE SKID PROBLEM"
0380 PRINT "ENTER VEL., COEFFICIENT OF"
0390 PRINT "FRICTION, ACCEL. OF GRAVITY"
0395 INPUT V,U,G
0398 PRINT #7;"VELOC.=";V;" ,MU=";U;"  G=";G
0400 LET D=(.5*V*V)/(U*G)
0410 PRINT "SKID DISTANCE = ";D
0415 PRINT #7;"SKID DISTANCE=";D
0420 END
```

Program 11. Brake Skid.

```
ACBDBCDACBTCBDL
DAILY=2.5 , TEST=2 , FINAL=2.2 , GRADE C
```

Example 12. Letter Average sample run.

```
0001 PRINT "GRADE AVERAGING"
0002 INPUT "PRINT PARTIALS (YES=1)",Q
0004 INPUT "NO. OF DAILY GRADES ",N
0006 INPUT "NO. OF TEST GRADES ",E
0007 LET X=.4:PORT=1
0008 PRINT "NEXT"
0009 LET P=1:INPUTG$:PRINT#7;G$
0010 REM
0020 LET A$=MID$(G$,P,1)
0030 IF A$="A"THENT=T+(4*X):P=P+1:GOTO10
0040 IF A$="B"THENT=T+(3*X):P=P+1:GOTO10
0050 IF A$="C"THENT=T+(2*X):P=P+1:GOTO10
0060 IF A$="D"THENT=T+X:P=P+1:GOTO10
0065 IF A$="F"THENP=P+1:GOTO10
0070 IF A$="L" THEN 130
0080 IF A$="N" THEN 4
0090 IF A$="T"THENX=.6:P=P+1:GOTO100
0095 PRINT "?":P=P+1:GOTO10
0100 LET S=T/N
0102 IF Q<>1THEN110
0103 PORT= 7
0104 PRINT "DAILY=";S/.4;", TEST=";
0110 LET T=0
0111 PORT= 1
0120 GOTO 10
0130 PORT= 7: IF Q<>1 THEN 135
0132 PRINT (T/E)/X;", FINAL=";
0135 LET F=S+(T/E)
0140 PRINT F;", GRADE=";
0190 LET T=0
0200 IF F>=3.5 THEN PRINT "A":GOTO 7
0210 IF F>=2.5 THEN PRINT "B":GOTO 7
0220 IF F>=1.5 THEN PRINT "C":GOTO 7
0230 IF F>=.5 THEN PRINT "D": GOTO 7
0240 PRINT "F":GOTO7
```

Program 12. Letter Average.

tire. The speed (in proper units), the coefficient of friction and the gravitational units are entered. The program then prints the skid distance. 44 ft/s equals 30 MPH and 32 ft/s/s is the acceleration of gravity in the English units. Tires on asphalt equal .8. The weight of the car, truck or cycle doesn't matter.

Letter Average

Program 12 allows a teacher to enter a string of letter grades and get the average—for instance, ABCBCACBDCBCDACDTCBBL. The T indicates that the next grades will be test grades and the L is entered as the last character. (See Example 12.) After the string is keyed, hit a carriage return. In our system, the daily grades are 40 percent so each of them is multiplied by .4. Tests are 60 percent so they are multiplied by .6. If you want to change the total number of grades type an N and a carriage return.

Numerical Average

Numerical Average (Program 13) takes number grades (98, 78, etc.) and averages them. The operator does not enter a zero for missing grades. A zero means that the following grades are tests and a negative number means all grades have been entered for that student. A printer is assumed to be on port 7. Dailies are again 40 percent and tests are 60 percent. The name, daily average, test average, overall average and letter grade are printed. Lines 130–160 are the letter-grade breakdown and may not apply anywhere else.

Conclusion

I hope these programs will bring other teachers out into the open to exchange programs. Some of these programs may not be the best for a particular situation, but they might open the way for a better application. I am developing a classroom package in 6800 machine language to do all the horrendous bookkeeping required of a classroom teacher. If your department budget could afford a micro system, many chores could be performed easily. A computer will turn students on, and also be a fantastic slave to work for you. ■

```
***
NAME          DAILY TST AVG GRD
--------------------------------
DAVE ONEIL 80    88  85  C
```

Example 13. Numerical Average sample run.

```
0004 LET P=7
0005 REM PRINTER ASSUMED TO BE ON PORT 7
0006 PRINT
0007 PRINT #P  ;"NAME        DAILY TST AVG GRD"
0008 PRINT #P  ;"--------------------------------"
0025 PRINT "ENTER NEGATIVE SCORE WHEN FINISHED WITH "
0026 PRINT "CURRENT STUDENT'S GRADES."
0027 PRINT
0031 INPUT "NO. OF DAILY GRADES ",D1
0032 INPUT "NO. OF TEST  GRADES ",T1
0033 PRINT : PRINT"ENTER GRADES AFTER 'NEXT ?' APPEARS"
0034 PRINT "-ENTER ZERO(0) PRECEDING TEST SCORES-"
0035 PRINT "DO NOT ENTER MISSING SCORES !!"
0036 PRINT
0037 LET M=.4
0040 INPUT "NAME (OR INITIALS) ",N$
0050 INPUT "NEXT ",S
0060 IF S>100THEN36
0070 IF S<1 THEN 90
0075 LET T=T+S
0080 GOTO 50
0090 IF M=.4 THEN A=M*(T/D1)
0091 IF M=.4 THEN A1=A:LETT=0:LETM=.6:PRINT"TESTS":GOTO50
0092 IF M=.6 THEN A=A1+(M*(T/T1))
0093 LET A2=T/T1
0094 LET A2=INT(A2+.5)
0095 LET A=INT(A+.5)
0096 LET A1=A1/.4
0097 LET A1=INT(A1+.5)
0100 PORT= P
0120 PRINT N$;TAB(12);A1;TAB(18);A2;TAB(22);A;TAB(26);
0130 IF A>93 THEN PRINT"A": GOTO180
0140 IF A>85 THEN PRINT "B": GOTO 180
0150 IF A>76 THEN PRINT "C": GOTO 180
0160 IF A>69 THEN PRINT "D": GOTO 180
0170 PRINT "F"
0180 PORT= 1
0190 LET T=0
0200 GOTO 36
```

Program 13. Numerical Average.

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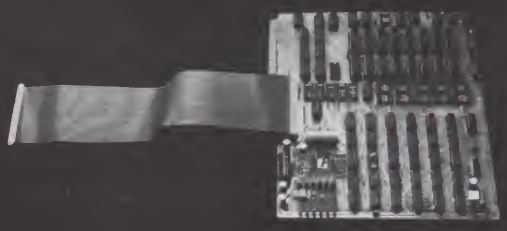
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As of June 1, 1980

Computer Education and Vocations

Students pursuing computer careers have many post-high-school alternatives to consider.

Peter A. Stark
PO Box 209
Mt. Kisco NY 10549

Books and magazines such as *Microcomputing* are excellent for learning about computing. But there are times when a more formal education is in order. Especially when it comes to your getting a job, many employers are more interested in your degree or diploma than in your magazine subscriptions. Here is some information on computer education and where to get it.

Computer-related courses are generally taught by the following types of schools:

- Home-study schools
- Private "computer schools"
- High schools (adult-ed courses)
- Technical institutes
- Junior and community (two-year) colleges
- Four-year colleges
- Graduate schools

Home-Study Schools

Home-study schools aren't very good for the full-time student because they aren't intensive enough to keep him busy. They are great for the part-time student who wants to learn a subject while working at some other job.

An advantage of home-study schools is that they let you study at your own pace, without the pressures of constant homework and surprise tests.

A disadvantage is that you cannot visit the school and examine its program and equipment before paying for the program (some states may have consumer-protection legislation to help solve problems). Although most home-study schools are reputable and worthwhile, some may not be.

Many home-study schools have no established program to drop students who are not making adequate progress. Hence, many employers distrust a diploma from such a school. In any case, home-study schools generally offer career-oriented, rather than academic-oriented, schooling.

Some well-known home-study schools are:

NRI Schools
McGraw-Hill Continuing Education Center
3939 Wisconsin Avenue
Washington DC 20016

Cleveland Institute of Electronics
1776 East 17th Street
Cleveland OH 44114

Grantham College of Engineering
PO Box 35499
Los Angeles CA 90035

National Technical Schools
4000 South Figuroa Street
Los Angeles CA 90037

An excellent collection of home-study courses and trainers is available from the Heath Company, Benton Harbor MI 49022. Heath's microprocessor course uses the Heath ET-3400 Trainer and a variety of extra parts. We use almost two dozen of these trainers in our school, and find them useful for teaching both programming and hardware. The Cleveland Institute of Electronics and National Technical schools also use Heath equipment and trainers.

Most home-study schools combine specially written texts with lab experiments using test equipment and trainers supplied as part of the course. This is more expensive than text-only training, but the practical experience you get is invaluable.

Some schools offer equipment which, while sufficient for learning, outlives its usefulness once your course is done. Others use equipment which is close to professional quality and is useful even after completion of the course.

Most such schools are accredited by the National Home Study Council, but a more valuable criterion is whether a school is "approved for veterans training." This approval often involves inspections by the Veterans Administration or by the state education department; both tend to take strong action when a program is below par.

Private "Computer Schools"

Private computer schools often advertise in local newspapers, on buses and on radio and TV. Often called proprietary, they are in education as a business—to make money. As such, their ethics are no different than those of any other business—some are ethical, some are not. Remember that the interviewer or counselor who talks to prospective students is often a salesman who works on a commission basis. Anything he says must be taken with a grain of salt.

Most computer schools specialize in training for three specific jobs: keypunch or data-entry operators, computer operators and programmers.

A data-entry operator sits at a keyboard and types in data from written forms such as sales slips or bills. Data entry was formerly done on keypunch machines that punched holes into cards; more modern machines record the data directly on tape or disks. Data entry requires typing ability and agility, rather than mental concentration. Expert data-entry operators can transcribe data from bills without having to think about it.

Data-entry operators are paid more than typists, less than good secretaries. In general, the job is a dead-end one, partly because there are few opportunities for advancement, partly because new electronic equipment makes it possible to enter printed and hand-written data directly into computers. A data-entry course should take no more than a few weeks.

Unlike data-entry operators, computer operators work directly with computers. They may feed input data into the computer on cards, tape or disks; start and stop programs; collect and distribute computer out-

---

Pete Stark is professor of electrical and computer technology at Queensborough Community College, City University of New York, Bayside, New York. He is the author of *Introduction to Numerical Methods* and other books. He is also an associate editor of *Kilobaud Microcomputing*.

put; and be responsible for computer operation. Since large computers are still fairly expensive, many companies try to use them 16 or 24 hours a day, so many computer operators work night hours.

A computer operator has a delicate job, since he handles delicate data and equipment and can cause damage if he makes a mistake. The job pays more than data entry, although the work is less strenuous and boring.

The most glamorous job of the three is that of the programmer, who prepares the instructions the computer uses to process its data.

Proprietary schools that claim to train programmers often don't tell the whole story. In many ways, programming is an art and programmers are like artists. Good programmers are as rare as good artists.

As a result, employers look for signs of more than average intelligence and savvy. A good sign of aptitude is a college degree or at least some prior experience in business or accounting. Some employers prefer to train business or accounting students who have no programming experience, rather than hire a graduate of a commercial computer school.

This means that if they get a job at all, most programming students wind up as computer operators. In any case, programming trainees are not as well paid as the general public thinks. The $25,000-plus salaries go to senior programmers and systems analysts — the people who analyze the problem and prepare written instructions and specifications for the programmers to follow when writing a program. Most of these people are college graduates, not graduates of commercial computer schools.

Proprietary schools commonly use an "aptitude test" as a means of enticing future students into joining. Although a programmer's aptitude test has for many years been used by employers and schools, most professionals in the business agree that the only real way to evaluate the work of a programmer is by seeing him work.

Proprietary schools have a bad reputation in the commercial computer world. An article in *Datamation* magazine a few years ago painted an unflattering picture of these schools. According to the article, most of them have outdated or nonexistent equipment for their students, and many instructors in such schools are either inept, or else are professional programmers who are between jobs and leave as soon as they find a new one.

These schools sometimes make unrealistic claims concerning job placement and salaries of their graduates. A booklet called *Check It Out* (available free from Computers, New York State Consumer Protection Board, 2 World Trade Center, Room 8225, New York NY 10047) describes computer schools. Even if you don't live in New York state, you may find this booklet useful in evaluating such schools elsewhere.



Our TRS-80 room is occupied from morning to night. Although there is a lot of game-playing, this soon leads to more serious programming in BASIC. This photo was taken before we converted all the TRS-80s from cassette to disk; cassette storage was too unreliable for most students.

Despite all my warnings, there are some excellent schools in this category. New York City's Control Data Institute, for example, has an excellent reputation.

Adult-Ed courses

Many local high schools, cooperative education services and colleges offer evening and weekend adult-education classes. Most of these are offered by publicly financed schools, which are less profit-motivated and so tend to mislead students less.

Since there is so much variability between schools, I can say little about them. However, adult-ed courses are generally a safe bet. Since your investment in money and time is minimal, little will be lost if the program is not up to par.

Technical Institutes

Technical institutes are somewhere between high school and junior college, although in some states a technical institute (or technical center) is roughly equivalent to a junior college.

A high-school degree is generally required for admission, and most technical institutes have well-defined rules for eliminating students who do not perform up to some standards. In fact, this may be a good way to tell a good tech institute from a bad one. The higher-level technical institutes — the ones like junior colleges — are usually accredited by the same organizations that accredit colleges.

Some technical institutes are purely money-making organizations, some are publicly owned. Within each type, there are good ones and bad ones. Identifying which is which is not easy.

The difference between a technical institute and a proprietary computer school lies in two areas. The computer school often has only one or two programs, which specifically deal with computers, whereas the technical institute may have a variety of programs in computers as well as other fields.

A technical institute usually occupies an entire building or even a campus consisting of many buildings. Most computer schools, on the other hand, rent space in office buildings. They are inherently a lower-budget operation, and may not have a long history.

Since technical institutes generally have a campus and some buildings and facilities, a visit is worthwhile. I have made accreditation visits to technical institutes and junior colleges. Visiting the laboratories, library (to see whether there are enough materials available to the interested stu-

dent) and bookstore (to see what textbooks are used) is valuable. Sometimes a short talk with the bookstore manager or the students working at the cash register tells me more about a school than everything else. (These hints work for other types of schools too.)

Ask for information about job placement of graduates: numbers of students placed in jobs, and the kinds of jobs and the employers. A good school should have no trouble placing its graduates in computer jobs.

Computer education is no good without adequate equipment. Any reputable school should have no objection to letting a prospective student tour its laboratories, though an appointment may be necessary. The equipment should be modern, and there should be enough of it so that no more than two or three students are at a lab station.



This is part of out SWTP 6800 facility, which is used for teaching machine- and assembly-language programming. We have seven such systems, all of which now have a floppy disk, CRT terminal and printer. We use 6800s because they are easier to program than Z-80s or 8080s.

Most technical-institute programs last about a year and result in a diploma in a specific career field. Technical institutes may offer programs in programming and computer operations (seldom data entry), as well as computer hardware.

Junior and Community Colleges

Since I teach in one, I am most familiar with the programs offered by two-year colleges. I think many offer opportunities for a good education at a reasonable cost. The difference between a technical institute and a two-year college is in the degree offered and the courses required for that degree.

A technical-institute diploma may have no legal standing—it is a piece of paper stating that a student has attended a certain school for a certain amount of time. A two-year college degree, on the other hand, is generally called an Associate in Arts (AA), Associate in Science (AS) or Associate in Applied Science (AAS). The associate's degree has a legal standing, and requires that the school obtain approval from a state department of education before it can confer this degree on a graduate. (In some states, two-year colleges may be called institutes, and may also confer an associate's degree.)

In order to grant an associate's degree, the school must satisfy some minimum requirements of the state. These generally relate to quantity rather than quality. For instance, the program may have to consist of a certain number of courses in math, sciences, English and humanities. Technical institutes often offer only technical courses, while two-year colleges may have to offer additional subjects. A two-year college may offer the same amount of technical material in two years that a good technical institute teaches in just one year.

Though this sounds like a disadvantage, many employers prefer employees who have taken the more traditional college courses, because they feel that these subjects improve other skills, such as writing and expression of ideas.

An associate's degree has one other advantage over a diploma: with this degree, you can often continue as a third-year student at a four-year college. Two years at a junior college may be preferable to two years at a four-year college. If at the end of the two years you decide not to continue school, at least you have a degree in hand and can get a job; a four-year-college dropout doesn't have nearly as good a chance.

Two-year colleges have a variety of programs related to computers:

- Business data processing, leading to jobs as computer operator or junior programmer.
- Scientific data processing, leading to jobs as programmer for scientific applications.
- Mathematics or pre-engineering.
- Electrical technology.
- Computer technology.

The latter two programs generally include some programming, but lean more toward the hardware aspects of computers.

In order to exist, a two-year college (like its four-year counterparts) must be accredited by the state as well as a regional accrediting society. Accreditation provides some guarantee that the college satisfies at least minimal standards. For example, colleges in my area are accredited by the Middle States Association of Colleges and Secondary Schools; other areas have their own regional accrediting groups.

Technology programs are also often accredited by the Engineers Council for Professional Development, an organization supported by 17 engineering societies, which accredits technology and engineering programs. Each year, the ECPD publishes an annual report that lists all the accredited programs throughout the U.S. The report is available at many libraries, or from the ECPD, 345 East 47th Street, New York NY 10017.

The 1979 report lists accredited computer-technology or related programs at the following schools:

Univ. of North Carolina at Charlotte
Lake Superior State College (MI)
State Technical Institute at Memphis
Milwaukee School of Engineering
Chattanooga State Technical Community College
Kansas Technical Institute
Oregon Institute of Technology
Memphis State University
Wake Technical Institute (Raleigh NC)
Southern Technical Institute (GA)
University of the D.C., Van Ness Campus
New York Institute of Technology
Hartford State Technical College (CT)
Queensborough Community College (NY)

In addition to these, many colleges offer electrical-technology programs that have digital and computer courses. In addition, many good colleges simply have not applied for ECPD accreditation. There are thousands of such colleges throughout the country, so a visit to your local one can be fruitful.

To give you an idea of what you might expect at a two-year college, here is a summary of what we offer at Queensborough Community College.

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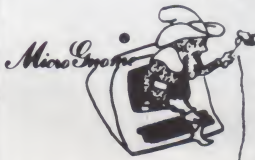
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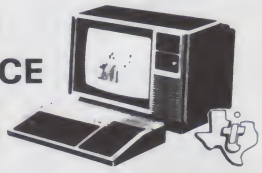
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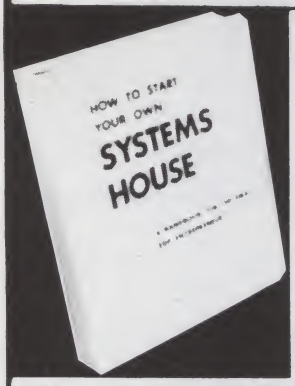
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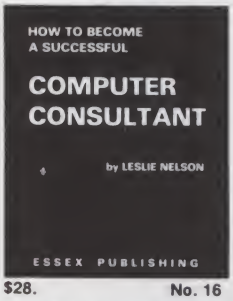
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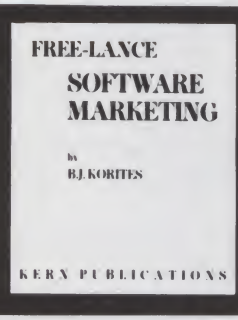


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by Leslie Nelson, May 1980

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in computer engineering technology. These two-year programs result in the AAS degree. The two years are divided into four terms, each lasting fourteen weeks and providing 20–25 hours per week of class and laboratory sessions.

AAS in Data Processing

First Semester
- Business Organization and Management
- Introduction to Business Data Processing
- English Composition
- Economics
- Health Education
- Physical Education

Second Semester
- Principles of Accounting
- Mathematics
- Programming in COBOL
- Systems Analysis and Design
- English Composition

Third Semester
- More Accounting
- More Programming in COBOL
- Computer Operating Systems
- Science (Biology, Chemistry, Physics or Geology)
- Social Science or History

Fourth Semester
- Statistics
- Programming in Assembly Language
- Data-Processing Projects Course
- Business Elective
- Free Elective

This data-processing program trains students straight out of high school for jobs as programming trainees, console operators and other computer-center personnel.

Such a program should have access to an on-site computer system of the type generally used in business installations; in practice, few schools can afford big computers, so often they use an RJE (remote job entry) terminal tied to a remote computer. In our DP program this terminal ties in to a dual IBM/Amdahl computer installation that belongs to the City University of New York. An RJE terminal allows you to enter and run big programs on the remote computer as if it were local. This is fairly standard in college data-processing programs.

As to micrcomputers, most data-processing people are just now finding out about them. Few, if any, teach programming or operation of small systems.

Computer Engineering Technology Program

Unlike a business data-processing program, which is generally taught by instructors trained in business and not hardware, engineering-technology programs are most often taught by engineers (though, in some areas, technology programs are taught by ex-industrial-arts teachers). They are oriented toward scientific programming and computer hardware. Our own program, which follows, is completely staffed by electrical engineers, all of whom have advanced degrees in engineering.

First Semester
- DC Circuits
- English Composition
- Health Education
- Physical Education



This Data General computer contains two hard disks as well as a floppy disk. It is useful for teaching BASIC, FORTRAN and advanced operating-system use.

Technical Mathematics
Social Science or History
Second Semester
AC Circuits and Transients
Electronic Devices
Computer Programming in BASIC and FORTRAN
Technical Mathematics
Physics
Third Semester
Electronic Circuits
Computer Project Course
Computer Programming in Assembly Language
Computer Circuits
Technical Mathematics
Physics
Fourth Semester
Computer Control Systems
Computer Circuits and Systems
Computer Input/Output
English Composition
Social Science or History

It's important to realize the difference between engineering and engineering technology. The ECPD defines them this way:

Engineering is the profession in which a knowledge of the mathematical and natural sciences gained by study, experience and practice is applied with judgement to develop ways to utilize, economically, the materials and forces of nature for the benefit of mankind.

Engineering Technology is that part of the technological field which requires the application of scientific and engineering knowledge and methods combined with technical skills in support of engineering activities; it lies in the occupational spectrum between the craftsman and the engineer at the end of the spectrum closest to the engineer.

Essentially, engineering is theoretical while engineering technology is practical. Engineering curricula in four-year schools are mainly theoretical, with few (and often badly equipped) laboratories. Technology programs are practically oriented and rely on laboratory experiments. In our case, every electronics or computer course includes a laboratory.

Modern and complete laboratories are essential to a technology program. In our computer technology labs we have an IBM 1130 computer, a DEC PDP-8e computer, a Data General Eclipse S/130 computer, eight SWTP 6800 microcomputers, 21 Heath ET-3400 microcomputer trainers, 14 Radio Shack TRS-80 computers.

In addition, a technology program also needs lots of support equipment; for instance, our laboratories include over 50 oscilloscopes, dozens of digital meters, seven logic analyzers, frequency counters, power supplies, signal and pulse generators, waveform analyzers, plotters, servo systems and digital logic trainers.

The point is that junior and community colleges, which are often affiliated with large universities and state or local governments, frequently have more qualified faculty and better equipment at their disposal than small, private schools.

Technology programs are not limited to two-year schools. Many four-year schools offer technology programs that lead to a bachelor's or even master's degree in Technology (BT or MT). Even though most engineering schools and engineers tend to look down on BT graduates, the fact is that many BT graduates get as good, if not better, jobs than engineers in the same field.

The reason is simple—many employers prefer to hire someone who has extensive, practical laboratory experience and can immediately start working. Many graduating engineers have little practical knowledge and need extensive on-the-job training before they can do certain kinds of work.

The importance of this is that a graduate of an AAS engineering-technology program can transfer to a BT program, complete two more years of study and get a four-year degree. Many engineering schools accept technology graduates but give varying amounts of credits. Some two-year schools have excellent relations with nearby engineering schools, and their students may get almost full credit when they transfer to engineering. Top-notch engineering schools such as M.I.T. might require a technology student to start over again.

Engineering societies, and many engineers, do not like the emergence of four-year technology programs; nevertheless, these programs exist, and their graduates are in demand. The differentiation between the three kinds of graduates is that only graduates of engineering schools are called engineers. In some areas, state laws permit only registered professional engineers to call themselves engineers!

Graduates of two-year technology programs are generally called technicians, while graduates of four-year technology programs are called technologists. In many companies, though, good technologists have engineering job titles.

Excellent sources of information on two-year, as well as four-year, colleges are *Barron's, Lovejoy's* or other college guides available in bookstores.

Four-Year Colleges

Four-year programs related to computers break down into the categories of business systems, computer science, computer engineering and electrical engineering with a computer option.

Business systems are generally taught by business schools, and include subjects such as management information systems and modeling of business operations, as well as more traditional business subjects. You can obtain information on most such programs from the Data Processing Management Association, 524 Busse Highway, Park Ridge IL 60068. This organization administers a testing program that leads to a certificate in data processing. This certificate is hard to get and carries prestige among employers.

Computer science is, in my mind, a nebulous subject open to different interpretations. In many schools, computer science is taught by mathematicians and is more mathematics than science—though pure mathematicians look down at those teaching the computer-science courses.

In either case, computer-science programs tend to be theoretical rather than practical; in some colleges, computer-science students don't even take a course in programming a real computer. A mathematical computer-science program might have calculus; linear algebra; numerical calculus; probability and statistics; mathematical analysis; multivariable calculus; algebraic structures and numerical anal-

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ysis courses. A more practical computer-science program might include courses in programming, data structures, computer organization, programming languages, switching theory and systems programming. Combination programs add such courses as computer graphics, artificial intelligence, formal languages, simulation, theory of computability or sequential machines.

Although there is no formal accreditation process for computer-science courses, most schools do follow a suggested curriculum plan developed by the Association for Computing Machinery, 1133 Avenue of the Americas, New York NY 10036.

For obvious reasons, electrical-engineering programs have a lot of computer courses. In some engineering schools, computer courses are simply considered part of the electrical-engineering curriculum. In some schools the electrical-engineering department may have a dual name such as "department of electrical and computer engineering," or the department of computer engineering may be completely separate from the electrical-engineering department.

Whatever the departmental designation, since the hardware and software of computers is so intertwined, engineering departments teach hardware, programming and computer-science courses.

Almost all such engineering programs are accredited by the ECPD, though the number of programs specifically dealing with computers is limited; the latest ECPD report lists only the following:

Case Western Reserve University (Cleveland OH)
Univ. of Illinois at Urbana-Champaign
Iowa State University
Univ. of Michigan, Ann Arbor
Oakland University (Rochester MI)
Syracuse University (NY)
University of Illinois at Chicago Circle
Rensselaer Polytechnic Institute (Troy NY)
University of Connecticut
Washington University (St. Louis MO)
University of New Mexico
Massachusetts Institute of Technology
California State University, Long Beach
University of Massachusetts
Oregon State University
University of California, Berkeley
University of Santa Clara (CA)
University of Central Florida

Keep in mind that this list includes only computer programs specifically having ECPD accreditation for computers; almost every electrical-engineering program has optional computer courses; even some non-engineering schools have a variety of computer courses.

In Canada, engineering programs are accredited by the Canadian Accreditation Board (401-116 Albert Street, Ottawa Ontario K1P 5G3). As of late 1979, no strictly computer programs had been accredited, although several Canadian universities are well known in computer circles (for example, the Watfor FORTRAN compiler originated at the University of Waterloo, Ontario).

An excellent source of information on college programs of all kinds is a college guide such as *Barron's* or *Lovejoy's*.

Graduate Schools

Graduate schools offer master's degrees and doctorates in most of the fields listed above, though virtually no graduate programs are called "computer engineering." However, almost every electrical-engineering graduate program allows (and usually requires) the student to specialize in some field; so in many schools, computer engineering is covered under electrical engineering.

Graduate courses in computer science are common, but few business schools specialize in computers on the graduate level. This makes sense, since business applications of computers are seldom on a high enough level to justify granting an advanced degree.

Other Sources of Computer Education

If you are already working, don't overlook the possibility of company education. Many large and small companies offer worthwhile education programs for their employees. For instance, business firms have purchased thousands of the Heath microcomputer trainers to train their own employees. Even if your organization has no formal education program, it may be willing to buy some educational materials and trainers for you or your department's use.

It's tough to break into a field like programming—partially because there are so many incapable programmers in the field that companies are afraid to hire someone without excellent experience and references—but it is often possible to get "through the back door," that is, through accounting or bookkeeping experience. Years ago, programming was considered difficult, and the tendency was to hire someone who knew programming, then try to train him in the business or scientific knowledge he needed to do a specific job. Now a common approach is to hire someone who knows the background of what has to be done and teach him programming later.

Even if your computer knowledge is limited, if you're knowledgeable in some other area where computers might be used, you can still find a computer job by that route.

I've concentrated on computers in education, particularly as the subject relates to finding a job in the computer field. Use the information as a guide, and consult the sources I've mentioned for additional information.■

Educationews

Microcomputers in Canadian Education

According to Commodore Business Machines Limited of Canada, the microcomputer industry is exploding in Canada. With sales approaching $1 million per month, the educational market has emerged as a large segment of the overall market, continues Commodore, which announces the Commodore Education Advisory Board. This board will advise Commodore on ways the use of microcomputers can be developed in education.

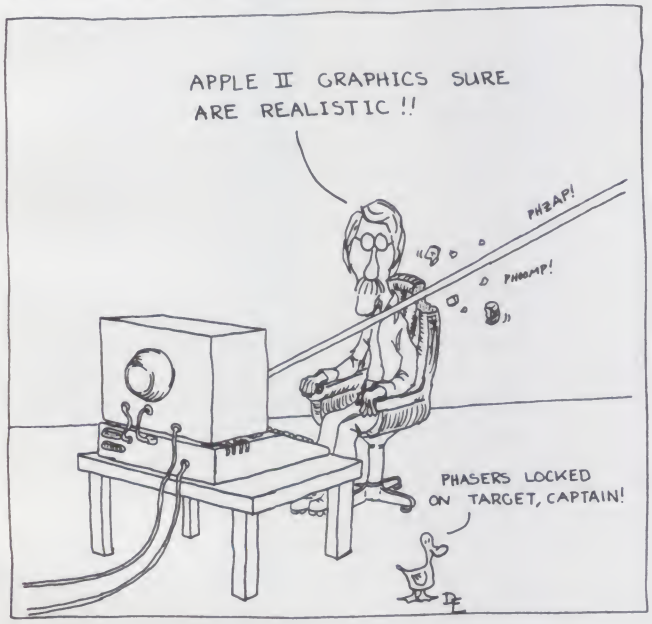
Initial board recommendations adopted include: the sharing of educational software across Canada; the creation of "Microcomputers in Canadian Educaton" newsletter; the loan and/or donation of hardware to schools developing software.

Commodore says that the PET is the largest-selling micro in Canadian schools, and estimates that nearly 1000 programs for the PET exist in the schools. According to Commodore, Canada is becoming the most advanced country in the use of microcomputers in the classroom.

Sourcebook for Educators

Available to educators is the 27-page *TRS-80 Microcomputer Sourcebook* from Radio Shack. It serves as a guide to the use of microcomputers as a medium and an object of instruction, and as a tool for school administrators. The sourcebook provides guidelines for selecting a system based on potential applications, costs, service and reliability. It is available free on request from Radio Shack, Dept. NR-17, 1300 One Tandy Center, Fort Worth TX 76102.

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Save Machine-Language Programs

Level II program lets you save any machine-language program on tape.

If you've purchased any programs, some of them are probably not written in Level II but in some strange language called *machine language*. These cannot be CSAVEd like other Level II tapes. You could buy T-BUG or Editor-Assembler just so you could make back-up copies, but the cost just to copy a few tapes may be a bit hard to justify.

You may even have one or two machine tapes that are difficult to load, and you know that if you make your own copies these programs would load much easier. You may even be using the POKE instructions to do some of your own machine-language programming that you'd like to save, yet you still can't see paying more money to purchase a program that you'd only use a couple of times. This Level II BASIC program will allow you to save any machine-language program on tape so that it may be reloaded using the Level II SYSTEM command.

The Program

The program is written in Level II BASIC so it can be CSAVEd and CLOADed just like any other Level II program. The data statements contain a short machine-language program that is POKEd into memory every time the program is run.

The program asks for the starting and ending location of the machine program to be saved. The BASIC program assumes the addresses to be in decimal, but hex addresses can be entered if preceded by an H. If ENTER is pushed without entering an address, then the address in the machine-language program will be left unchanged. The short machine-language tape-save program is set up to save itself on tape if no other addresses are entered. The file name is entered as six characters maximum in the upper-left hand corner of the screen.

If the machine-language program is not a subroutine or has an execution address different from its starting address, then an execution address may be entered. If no address is entered for the execution address, the program substitutes the starting address.

Program Loading

The start location of the machine-language program is at 20480 decimal. The first data statement, 27th and 28th items, hold the LSB and MSB of the start address, while the 30th and 31st items are the LSB and MSB of the ending address. These are the data bytes that are changed when other start and end addresses are entered. The execution address is in the third data statement, the 28th and 29th items, with the least significant byte first.

The tape-save program is set up to store 64 bytes at a time, and then saves the checksum and current program address location. When the tape is loaded back in under the SYSTEM command, the asterisk will flicker every time the checksum is read. This value is in data statement 2, which is the fifth item. The smaller the value, the faster the asterisk will flash on loading, but the program will take slightly longer to load.

The small tape-save machine program is *not* location independent because of the use of four CALL instructions. These call out the subroutine at location 5070 (hex). These subroutine calls are located in data statement 2, items 14, 15 and 18, 19 and 23, 24, and in data statement 3, items 13, 14. If the tape-save routine must be moved, then the CALL address must be updated.

If you save the tape-save program as a machine-language program, you will have to type the file name of the program to be saved into the left uppermost corner of the screen and POKE the start, end and execute addresses into the proper locations before executing the tape-save program. It is best to execute the tape-save program using the USR (x) function, but the program can be run directly using the */ of the SYSTEM function.

The problem is that the tape-save program ends with a RETURN statement, which will create an SN or other types of error after execution. Remember that the address statements must still be POKEd, and the program's file name must be in the upperleft corner before the tape-save program is executed.

Modifications

The program has been set up for a 16K TRS-80 because the BASIC program takes up almost 3K of memory, which will leave only 1K for machine-language programs to be saved. For those few owners of 4K Level II computers, the program can be shortened by using the DATA and POKE statements from line 20 through 180. The machine-language tape-save program will have to be relocated changing the CALL instruction locations given above. The start, end and execute addresses must then be manually POKEd into their

proper locations.

If the RET instruction (the fourth data statement, fourth item) is changed to a JP 0A9A instruction, then variable XA will hold the execution address in decimal after the program to be saved has been saved. This may be important to some of you, especially if you plan on shortening the BASIC program and need to troubleshoot the machine-language tape-save program after relocating it.

The BASIC program may be loaded before or after any SYSTEM tapes have been loaded if the MEMORY SIZE is restricted to 20480 at power-up. Most SYSTEM tape programs reside at the high end of memory, but some programs reside in the first 4K of memory so the location of the machine-language save program at 5000 (hex) works well for most programs to be saved.

SYSTEM tapes can be loaded individually, and as long as they are not stored and do not modify the same memory locations, they can all reside in memory at the same time. This is not true of BASIC programs that are CLOADed. Only one BASIC program can reside in memory at a time. As soon as another program is CLOADed, the first is erased. The tape-save program can be loaded along with several other machine programs. Then a single tape may be set up to accommodate several machine-language programs—each program loaded one after another with its own six-character file name for easy retrieval. ■

```
10      REM
        *     TRS - 80  SYSTEM  TAPE  SAVE  PROGRAM     *
        *  VERSION 1.1 / OCT 23, 1979 /  B. PENHOLLOW   *
20 CLS
30 DATA 62,0,205,18,2,205,135,2,33,0,
        60,62,85,205,100,2,6,6,126,205,
        100,2,35,16,249,17,126,80,33,0,
        80,62,60
40 DATA 205,100,2,6,64,120,205,100,2,14,
        0,125,205,112,80,124,205,112,80,126,
        35,205,112,80,229,55,63,237,82,225,
        40,8,16,241,121
80 DATA 205,100,2,24,214,16,2,24,7,62,
        0,205,112,80,16,251,121,205,100,
        2,62,120,205,100,2,33,0,80,125,
        205,100,2,124,205,100,2
100 DATA 205,248,1,201,0,0,0,0,245,129,
         79,241,205,100,2,201,0,0,0,0,
         0,0,0,0
120       REM *  READ AND POKE DATA -TAPE SAVE PROGRAM  *
140 FOR X=0 TO 126
160 READ Y:POKE 20480+X,Y:NEXT X
180       REM * GET FILE NAME
200 PRINT@64,"ENTER PROGRAM NAME (6 CHARACTERS MAX.)"
220 FOR X=0 TO 5
240 A$=INKEY$:IF A$="" THEN 240
260 PRINT@0+X,A$
280 NEXT X
300 PRINT@128,"ENTER THE START ADDRESS";:INPUT AD$
320 GOSUB 1000:IF AD=0 THEN 360
340 POKE 20509,LSB:POKE 20510,MSB:SA=MSB*256+LSB
360 INPUT"ENTER THE END ADDRESS";AD$
380 GOSUB 1000:IF AD=0 THEN 420 ELSEIF SA>=MSB*256+LSB THEN 300
400 POKE 20506,LSB:POKE 20507,MSB:AD$=""
420 INPUT"ENTER THE EXECUTION ADDRESS";AD$:IF AD$="" THEN MSB=INT(SA/256):LSB=SA-MSB*
440 POKE 20574,LSB:POKE 20575,MSB
460 PRINT@448,"PREPARE TAPE RECORDER TO SAVE THE PROGRAM.
(TO RECORD A DIFFERENT PROGRAM, ENTER 'D')":INPUT A$:PRINT:PRINT:PRINT
480 IF A$="D" THEN CLS:GOTO 200
500 POKE 16526,0:POKE 16527,80
520 XA=USR(N):PRINT@64,:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT"     **   D O N E
540 FOR X=0 TO 750:NEXT X
560 GOTO 460
980       REM * CONVERTS  ADDRESS  TO  MSB  AND  LSB  DEC.  *
1000 IF AD$="" THEN AD=0:RETURN ELSE AD=1
1020 IF LEFT$(AD$,1)<>"H" THEN AD=VAL(AD$):MSB=INT(AD/256):LSB=AD-MSB*256:RETURN
1040 L=LEN(AD$):H$=MID$(AD$,L-1,L):GOSUB 1100:LSB=D
1060 IF L<=3 THEN MSB=0:RETURN
1080 H$=MID$(AD$,2,L-3):GOSUB 1100:MSB=D:RETURN
1100 HM=ASC(LEFT$(H$,1)):HL=ASC(RIGHT$(H$,1))
1120 IF HM<58 THEN HM=HM-48 ELSE HM=HM-55
1140 IF HL<58 THEN HL=HL-48 ELSE HL=HL-55
1160 D=HM*16+HL:RETURN
```

Program listing.

Acknowledgement

To John Sweeney of Albany, New York, for his $2 listing of a BASIC Disassembler, without which this program and article may never have been written.

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Ed Faulk, *Z-80 Programming for Logic Design TRS-80 Computing*, Vol. 1, No. 2,: "Level I & II ROM Routines," Osborne & Associates.

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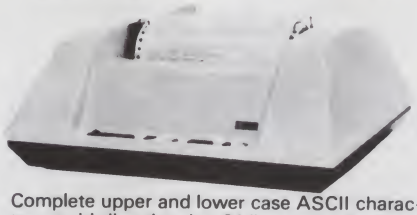
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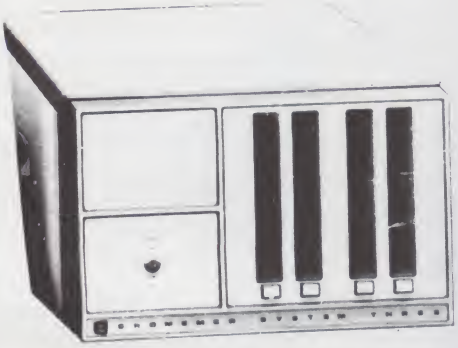
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One of the big complaints teachers have concerning reading instruction is students' lack of interest in reading. Television and other mass-communication media have proven more effective than the printed word in capturing children's attention. However, "Wonder Woman" and "The Six Million Dollar Man" have a new rival — the home computer. Instead of watching the bionic man wipe out the bad guys on TV, children can do it themselves via computer games.

In order to play the really fun games, however, the child must be able to read. Games such as Star Trek involve complicated directions, and even games like Number Guess or HI-LO require a little reading. So if the child wants to use the computer in any serious way, he or she will have to learn to read (which may be more motivation than many children had before the advent of home computers).

The purpose of this article is to present a way to teach some fundamental reading skills using a video terminal and a Tiny BASIC speaking computer. I chose Tiny BASIC to demonstrate how much can be done with a small amount of computer capability.

There are two separate categories of skills that a child must learn in order to read: The first is *decoding* — the skills needed to "sound out" words. Recognizing that the b in *big* has a different sound than the p in *pig* is a decoding skill. But just being able to sound out words does not guarantee that the child *understands* the reading material. He or she must be able to form mental images and interpretations of what the printed words stand for. This is *reading comprehension*.

For the purposes of this article, we will assume that the child has learned some of the basic decoding skills and is capable of making sense out of what is being read. Program 1 is a sample designed to help a child begin to associate the printed word with pictures. Presented with a picture in a booklet, the child has to select the word that goes with the picture from three choices on the computer. If the choice is correct, a line of stars appears, the screen is cleared and the next set of choices is given. If the child makes the wrong choice, another question mark appears below the first.

The pictures used with the program can be reproduced from books or cut out of magazines. These will be much clearer and easier to produce than most computer graphics. The pictures can be cut to size and taped to a page in a spiral notebook, which is then set on top of the video terminal or monitor so that pages of the notebook containing pictures will fall over the top half of the screen. The computer program will show the choices at the bottom of the screen. After correctly answering the questions, the child can flip the page up for the next picture.

Each picture should be identified with a number so the choices will be matched to the correct picture. The programmer-teacher should use the call-out "picture # " to avoid confusion with the answer choice number. Pictures should also be simple and uncluttered.

The words selected in this sample program are typical "primer" words familiar to a beginning reader. As the child progresses, the programmer-teacher-parent can use increasingly difficult words. Without going into a technical reading analysis, you can tell if the program is too difficult when the child makes too many mistakes. (I personally set the cutoff at 10 to 15 percent errors.) If the error rate is too high, redo the program with simpler words, using the child's performance as your guide — not some preconceived notion of how well the child *should* be doing.

You can build in an error identifier, if your BASIC supports arrays, by using the routine in Program 2. Note that this program is deliberately kept separate from the rest of the program, and is accessed with a GOTO 5000 command.

The program should not make a big deal out of wrong answers. I recently heard of a program that produced a beep for wrong answers to arithmetic problems. As soon as children using the program learned this, they deliberately chose the wrong answers to hear the sound of the beep! If your terminal can produce a bell or a beep, you can use this feature on *correct* answers by adding the following line (if, CHR is recognized by your BASIC):

```
3025 PRINT CHR (7)
```

Once the child has a good working knowledge of a basic vocabulary, the programmer-teacher-parent will want to try different types of reading activity based on picture interpretation. For example, you might show a person at work and present a choice of two words: (1) doing and (2) done, with (1) the correct choice. Another possibility is to show a picture of a new car and give two choices: (1) new car or (2) old car. Possibilities are endless, but you must remember not to let them exceed *the capabilities* of the child. ■

```
10 REM READING VOCABULARY PROGRAM
20 REM R IS THE CORRECT ANSWER CHOICE
30 REM P IS THE PICTURE NUMBER
40 REM CLEAR SCREEN TO START
50 GOSUB 3030
60 LET P=1
70 LET R=1
80 GOSUB 1000
90 PRINT "(1) BALL (2) BILL (3) LAB"
100 GOSUB 2000
110 LET P=2
120 LET R=2
130 GOSUB 1000
140 PRINT "(1) CAR (2) CAN (3) NIP"
150 GOSUB 2000
160 LET P=3
170 LET R=1
180 GOSUB 1000
190 PRINT "(1) DOG (2) DIG (3) GAD"
200 GOSUB 2000
210 LET P=4
220 LET R=2
230 GOSUB 1000
240 PRINT "(1) MAN (2) MEN (3) NAM"
250 GOSUB 2000
260 LET P=5
270 LET R=2
280 GOSUB 1000
290 PRINT "(1) CAP (2) CAR (3) CUR"
300 GOSUB 2000
310 LET P=6
320 LET R=3
330 GOSUB 1000
340 PRINT "(1) CANE (2) COAL (3) CAKE"
350 GOSUB 2000
360 LET P=7
370 LET R=2
380 GOSUB 1000
390 PRINT "(1) BAIT (2) BIKE (3) BOIL"
400 GOSUB 2000
410 LET P=8
420 LET R=1
430 GOSUB 1000
440 PRINT "(1) FISH (2) SHOW (3) FAST"
450 GOSUB 2000
460 LET P=9
470 LET R=3
480 GOSUB 1000
490 PRINT "(1) TRAP (2) TRAY (3) TREE"
510 LET P=10
520 LET R=1
530 GOSUB 1000
540 PRINT "(1) TRAIN (2) TRIM (3) TRUE"
550 GOSUB 2000
800 END
1000 PRINT "PICTURE #"; P
1010 PRINT
1030 RETURN
2000 REM RESPONSE SUBROUTINE
2010 PRINT
2020 INPUT Z
2030 IF Z=R THEN 3000
2040 GO TO 2020
3000 REM SCREEN CLEAR AND REINFORCEMENT ROUTINE
3010 REM CHOICES REPLACED AT BOTTOM OF SCREEN
3020 PRINT "****************************************"
3030 LET C=0
3040 LET C=C+1
3050 PRINT
3060 IF C <> 16 THEN GO TO 3040
3070 RETURN
```

Program 1. Sample program.

```
4 REM DIM THE NO. OF PICS IN THE PROGRAM
5 DIM A (30)
2025 IF Z <> R THEN LET A(P)=A(P)+1
5000 PRINT "ERRORS WERE MADE IN THE FOLLOWING"
5010 LET P=0
5020 LET P=P+1
5030 IF A(P) > 0 THEN PRINT P
5040 IF P=30 THEN STOP
5060 GO TO 5020
```

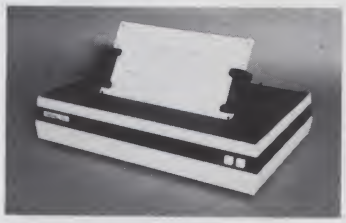
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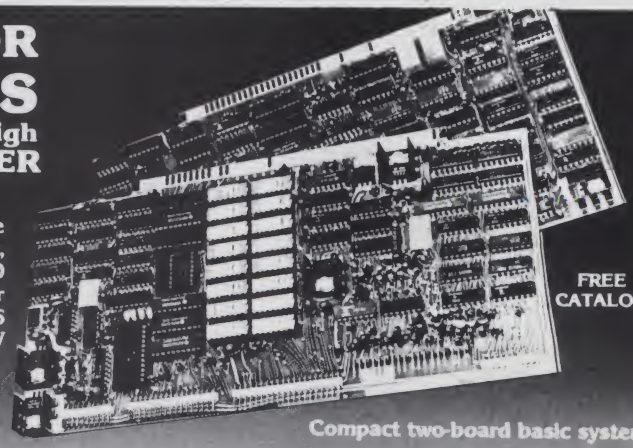
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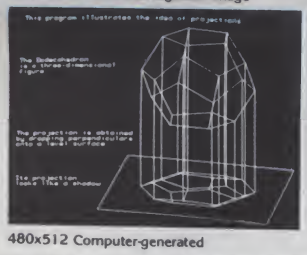
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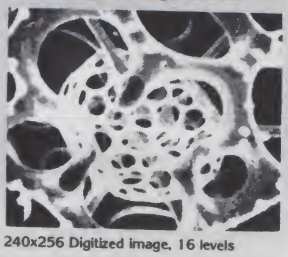
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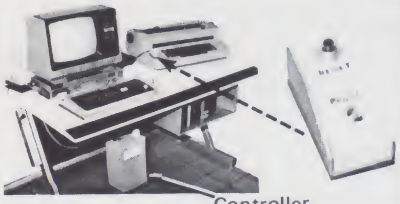
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Evaluating Small Systems Applications Software

Selecting small-systems software can be tough. Here's a guide to help you.

Russell W. Steele
838 Gayle St.
Papillion NE 68046

There are many approaches you can take when selecting applications software: do your own programming; hire a programming staff; buy a specific package designed for your type of business; or modify a general-purpose package to fit your unique requirements. To reduce software costs, software suppliers are providing general-purpose business applications packages, which are attractive due to their lower initial cost and wide user acceptance. The problem is to find the right package for your application.

Regardless of your approach —in-house development or commercial package—it's important to know the attributes of quality software. If you choose to develop your own software, these attributes can be incorporated into your requirements. If you're evaluating available packages, then these attributes are tools to assess potential software capability and performance.

I will only be discussing software attributes; there are a host of other attributes that should be considered, e.g., ability of supplier to provide support and his reputation for meeting commitments.

Software Costs

One generally accepted quality indicator today is cost. It appears that the old adage, "You get what you pay for," applies to applications software. It takes a lot of work by talented people to produce a high-quality product, and they are not going to give their creation away for nothing. Long-term systems support to the user must also be considered in the software costs.

However, price should not be your most important selection criterion, as some poorly written packages can also have a high initial cost. Regardless of its initial cost, poorly written software will have a higher cost of ownership. This is especially true when major portions of the software must be rewritten to meet your basic requirements.

In assessing the capabilities, limitations and cost of ownership, there are a number of attributes to be carefully examined: utility, maintainability, reliability, efficiency, human engineering, understandability and testability. The quality attributes tree (Fig. 1) illustrates the relationship between each of these attributes.

Initial Selection and Evaluation

The most important quality of any package is its utility to your present and future needs. Therefore, one of your first tasks is to determine your data-processing requirements. Make a list of your requirements, then discuss it with the people who currently accomplish the specific function you're planning to automate. Get their ideas and suggestions and compare them with your planned objectives. Very often suggestions from clerical and operations people can uncover requirements overlooked by managers.

Once your requirements are documented, select some candidate packages from the expanding number of applications software packages on the market. The size and configuration of your computer equipment and your basic automation needs should reduce the choices to a manageable size for the evaluation. Your next task is to rank-order the candidates based on a subjective analysis and other, applicable user evaluations. This data is available from trade journals, small systems users magazines and other users in your community.

Once you have selected your initial candidates, arrange for a demonstration. If your local computer store does not sell the particular package you're interested in, then write to the software supplier and ask for a list of users within a reasonable distance from your location. You may want this list even if the package can be demonstrated by a local dealer. Practical experience is one of the best methods of evaluation, and talking it over with an experienced user can be helpful.

When you conduct your evaluation, remember that your primary objective is to find a package that meets your own busi-

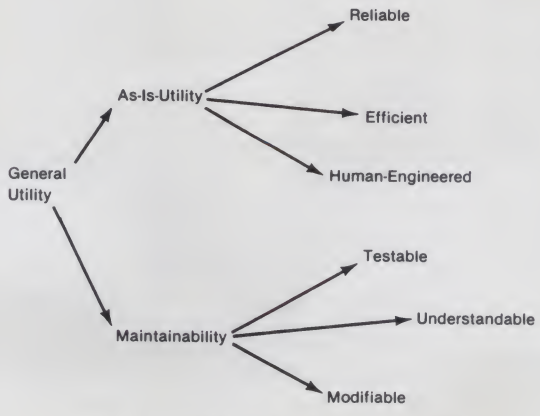


Fig. 1. Software quality attributes tree.

ness needs, not the best software package in the evaluation group. If you compare one against the other—rather than against your requirements—you may end up with the best package, but still not satisfy your specific needs.

At this point, if you do not have any previous automatic data-processing (ADP) experience, you may want to consider obtaining some professional help from a consultant or ADP professional who does business consulting on the side. Look for a consultant in the Yellow Pages of your phone book or contact the local computer store for a list of part-time consultants or potential candidates. In making your choice, it is important that you find a trustworthy individual without vested or conflicting interests. Choose carefully, because some consultants may have a close affiliation with the supplier or computer store selling the particular software you're evaluating.

Whether you do the evaluation or entrust it to others, it's important to draw up a plan and list those areas of vital interest to you and your business, and develop a selection checklist. You should consider the following qualities in the development of your selection criteria.

As-Is-Utility

From the quality attribute tree, we can see that the principal attributes for utility are reliability, efficiency and human engineering. Within this subset are conflicting attributes in the tree, so it's important to keep your evaluation in perspective.

For example, the most efficient software may not be the most maintainable or the most reliable in an operational environment. The generation of error traps and operator prompts takes up processing time, which can reduce throughput efficiency. Always remember to keep asking yourself: Will this package meet my needs, and what trade-offs can I accept?

Reliability

It may be impossible to verify any package under evaluation as totally error free. Software is not like a piece of hardware that breaks or runs too hot; nor does it wear out like a machine. At best, its utility just diminishes over time, and a package with more utility replaces it. A failure in the software is usually the result of a design deficiency or a coding error that escaped initial testing. In some cases, errors will not show up until the software is put into practical operation.

The key is a complete design that gives the software depth and promotes accurate coding. A reliable package will provide consistent operation under a wide variety of conditions. Remember: Reliability cannot be tested in; it must be designed in from the beginning. If the program fails during a demonstration, determine the specific reason: hardware, program bug or operator error. When combined with other performance data, your list of glitches may identify a trend that points to a specific weakness. As an example, the software may be demanding more from a disk than it was designed to provide.

The bottom line is to consider reliability in terms of the total system. Ask yourself, "Would I trust all my business records to this system?" An overextended floppy disk can be a disaster if it crashes and takes your only records with it.

Efficiency

Although efficiency is much more measurable than reliability, it is also subjective. The two principal efficiency considerations are system efficiency and lifecycle efficiency. The first concerns how the individual parts or modules relate to the whole package. For example: Are peripherals competing for the same resources? Is the memory allocated to I/O tasks effectively used? Are data transfers and printing being done at optimum speeds?

Lifecycle efficiency involves the ability to modify processing loops for current workload cycles to accommodate future needs. Initially, you may only have a single terminal in the stockroom or shipping and accounting departments.

As your business grows, you may need additional terminals in the stockroom. It should not require an extensive and costly rewrite to modify the software to handle these additional terminals. Hopefully, you will not be locked into a set number of terminals, with no room for expansion. Many times your initial workload assumptions may have been invalid, especially for seasonal situations. The software should support these changing workload conditions.

The documentation supplied with the package should provide the necessary data for fine-tuning your software to operate efficiently under different workloads.

The documentation supplied with the package should provide the necessary data for fine-tuning your software to operate efficiently under different workloads. To do this, you must have the necessary system software tools to monitor program flow and analyze cycle times: a trace function to monitor the behavior of variables or functions under certain conditions or an execution monitor to record discrete events.

If your system does not support these functions, then you can make selective dumps using the PRINT statement. By temporarily inserting the PRINT statement in selected modules, it is possible to examine the operation of control loops and inner subloops. Adjustment to these control loops can increase the efficiency of the software under various operational conditions.

Other efficiency considerations are how the software handles your data files when searching, sorting and updating and the calculations made in processing the final products. Data-handling algorithms should be optimized for your specific needs, as should the file structure. For example, sorting routines should be optimized for your data types.

File structures should promote rapid sorting and list preparation. Algorithms should be provided for specific functions such as bulk mail sorting or check preparation. Efficient data handling is to your benefit, since it frees the computer for other tasks.

Review algorithms to ensure that calculation accuracy is not greater than necessary. Increased accuracy takes time and consumes valuable memory to store extended numbers. For example, a TRS-80 integer uses two bytes; single precision numbers use seven bytes; and double precision numbers use 11 bytes. A single precision, or integer, number takes less memory. It's inefficient to calculate the number of stock items on hand to six decimal places; an integer should do.

Another important feature is the ability to bypass unnecessary calculations. It also increases efficiency to reorder program options so the most often used routines are executed first.

Human Engineering

This attribute concerns the operator or user interface. Many software packages were not written with the end users (operator, clerk and manager) in mind. Programmers often write a package they can understand

and use, but the end user—usually with little professional ADP training—may find it difficult to operate. When a glitch or bug develops, the programmer will know how to correct it; on the other hand, a clerk will feel lost and frustrated. This frustration will soon grow into dissatisfaction and dislike for the system; therefore, it's important that you pay close attention to your operator's needs.

Your manager should also be given equal consideration. A manager who receives the final output products will also develop negative feelings about the system if the output does not meet his needs. He wants timely outputs that are easy to read and can be applied directly to his responsibilities. If he must plow through numerous printouts to assemble figures that could have been displayed on a single page, he will soon abandon the system altogether and build his own manual record-keeping system.

From a human-engineering standpoint, the systems operator is concerned with the mechanical operation of the system and the input/output procedures; whereas, the manager is interested in the output and its utility.

From an operator's viewpoint, all hardware subassemblies should be compatible and not require three hands to operate. This is important in both normal and degraded modes. If the system must be operated in a degraded mode, the operator should be able to select specific alternate actions that will aid in system recovery.

The skill level of the operator should also be considered—during normal, crisis, maintenance and training modes. It's helpful if the system is designed to record operator actions for review after the emergency has passed or the training session is complete. This is most helpful during training sessions and can go a long way toward preventing repeat operator problems.

You could also add safeguards that prevent the initiation of undesirable system actions and reduce operator problems. For example, single key initiation of critical functions can significantly increase the error factor and reduce operator efficiency. In short, the system should not waste the operator's time and energy.

Data entry is a critical function that should be given high priority in your review process, because if garbage gets into the data, the most likely output will also be garbage. Therefore, the input form, format, units and sequence of entry should be as convenient and as easy as possible to use.

When duplicate entries are required, the user should not have to respecify or reenter the same inputs. All inputs should be frequency-optimized so those most often entered are easiest to put in a data file or calculation.

Critical entries should be safeguarded against accidental modification or the initiation of undesirable actions. For example, when you calculate stock markups and profit margins on a new product, a misplaced decimal point could mean the difference between a profit or loss. There are numerous unique examples for every business, so all business software should have a review option prior to data entry.

Another useful tool is the capability to review calculations prior to final entry in a record. It's much easier to review a short sub-list of inputs rather than have to reenter the data for a comparison and validation run. It's also vital that the system documentation provide a complete list of all inputs with an appropriate explanation of each and how they are handled by the software. Input menus can also be an important time-saving tool.

Input is not the only place cost savings can be accrued. An effective output format can save managers countless hours. Like the inputs, the outputs should be in the form, format, units, sequence and medium most convenient to the user. The output should assist the user in the decision-making process and not hinder him by making the results difficult to understand or relate to one another.

> **One of my pet peeves is the use of the cute, but illogical, data names and labels used by some programmers.**

The timeliness of the output is also an important consideration. For instance, can a user request intermediate results? Can error correction be accomplished based on initial review of the output? If required, can post-processing options be exercised to expand or reformat the output?

One other important consideration is the labeling of outputs in a language easily recognized and understood by the reader, not in obscure acronyms or truncated labels. Looking through a pile of printouts to find a report that looks like all the others can be a frustrating experience, especially when an important client is on the telephone waiting for the data. System outputs should always be designed to help you or your managers make decisions and increase your efficiency. It's been my experience that those outputs not meeting this important criterion are rarely referred to and often go unread in a bottom drawer or the trash can.

Maintainability

The other principal branch in our quality attributes tree is maintainability, which is the ability to modify the software to meet your needs and test the integrity of the software after the changes are implemented. However, neither function can be accomplished economically unless the software is understandable. To be understandable to the software maintenance programmer, the software must have clear code and evident logic. To accomplish this clarity of purpose, the code modules should be self-descriptive; the structure should be simple and, where specific conventions have been established, within the programming standard.

As you can see, the three maintainability branches of our tree are interrelated and overlap in many areas. When buying a commercially available package, you do not have an opportunity to establish specific requirements for the programmer; however, you should still review the candidate packages against some general programming standards. For example, is the structure of the code uniform throughout? Is the use of subroutines, variables and error flags consistent throughout? Is each block of code of reasonable length (200 statements or less has been suggested as a logical limit)?

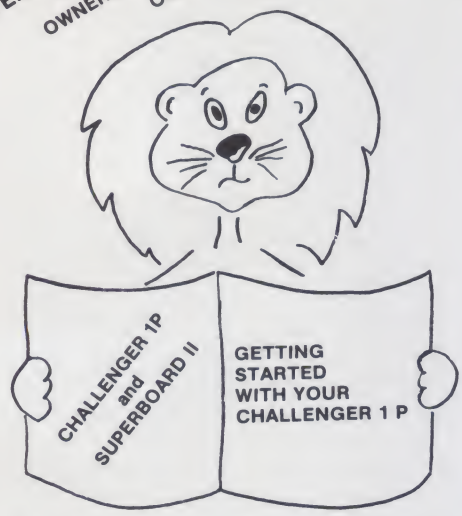
Program comments should include a header that gives the name and purpose as well as the calling sequence for the routine. Input/output restrictions should include explanatory comments clearly offset from the code. It's also helpful if the comments are uniformly indented and separated by blank lines or some distinctive notation.

The code should also be grouped together to aid in debugging and modification. For example, format statements should be grouped in a specified area of each segment or structured block. The data declaration should also be grouped and arranged in a logical order. Columns are much easier to read than long lines of data across the page. Long horizontal strings are hard to track with the eye.

One of my pet peeves is the use of the cute, but illogical, data names and labels used by some programmers. I am sure

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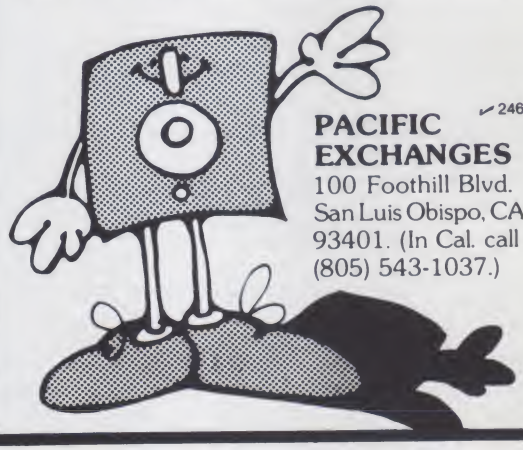
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that they made sense to the original programmer, but the maintenance programmer doesn't know that the labels were derived from mathematical manipulation of the original programmer's first and last name. All names and labels should be meaningful to the intended function. Except when required to conserve memory space, each line of code should contain only one statement.

Other important features include the geometry of error and diagnostic message formats. These messages should also be in plain text and not require an operator to resort to a lookup table. I am constantly looking up error codes for my TRS-80 Level II. My next system will have plain text error codes. For now, I must be content with self-explanatory error codes and prompts I write into my programs.

You should also examine the use of variables looking for their modification in loops. Loop variables should not be modified during execution, nor should a variable be assigned a constant value, especially within a loop.

Documentation

Good documentation, which clearly and concisely describes the software and its conventions, is also a vital part of maintainability and should conform to a general standard. One of the first items you should look for is its readability. Documentation should be in plain, understandable English.

Other features to look for in the documentation include variable name and subroutine dictionaries, cross-references and a definition of terms and assumptions under which the software operates. If the programmer knows of any changes that may have significant or unexpected side effects, he should adequately warn the user in the documentation.

By examining the documentation, you should be able to clearly follow the program control and data control structure. These two structures should remain independent of each other so that changes to one will not adversely affect the other or require a corresponding modification.

> **By examining the documentation, you should be able to clearly follow the program control and data control structure.**

It has been my experience that documentation is one of the weakest links in the maintainability chain. It's often less time-consuming and expensive to totally rewrite a program than to modify one without good documentation. It's unfortunate that writing the documentation is often the last activity prior to marketing the package and often receives the least attention.

Good software design requires the concurrent generation of the documentation in parallel with the program. If the program and its description are produced concurrently, the little details required for a thorough document will not be forgotten. A well-documented package is most often a good quality indicator and attribute. Look carefully at the documentation.

Software Modification

If it's possible for you or your programmer to understand the logic of the software, follow the control structure and appreciate its limitations and constraints, there is a high probability it can be modified to meet your needs. If the software is highly structured within well-disciplined modules, the extension of the software or its modification will become much easier.

There are a number of assets accrued from module code: the time to modify the code can be minimized by using previously written modules. It's simpler to understand because most modules are limited to less than half a dozen loops or branches. Testing is also simplified by limiting the number of execution paths within a module.

One of the hardest jobs for a programmer is to unravel another programmer's logic from a poorly documented and unstructured program. If you're paying a programmer to modify a commercially available package, be aware of the hidden costs in rewriting a poorly written program.

Testability

A software package for sale should be thoroughly tested in the laboratory before being put on the market. These functional tests using simulated data should identify any catastrophic errors and isolate major design deficiencies. It's highly unlikely that all the possible errors will be found, as the system may or may not have been tested in an operational environment with live data. A mature program on the market for some time will have many operational bugs worked out, but you will still need to evaluate it in your business environment.

A point to remember is that testing only identifies errors, not the absence of errors. Some errors may never be detected. The production of totally error-free software is not economically feasible; it simply takes too much time and money to find that last error.

When conducting an evaluation, you should concentrate on user acceptance testing. During this phase, your primary goal should be to ensure that the software operates in a predictable way in your specific application. Here you will develop sufficient confidence in the hardware and software to entrust your business records to the system.

How much testing does this require? The extent of testing depends on a number of factors: the complexity of the system, the importance of the system to the survival of your business and the resources available to conduct the test. As a minimum, you should prepare a testing plan that describes your test procedures and establishes methods for correcting and updating the software should you choose to buy it. If possible, run both the proposed system and your old method in parallel.

In addition to building confidence in the system, acceptance testing introduces your operators to the applications software. It's here that the man-machine interface deficiencies—confusing instructions, obscure error codes, operational incompatibilities—will show up.

For your ADP conversion to be successful, your employees must also develop confidence in the system. They must have confidence in the validity and integrity of the output, or they will develop inefficient manual back-up systems. Also, if your people do not have confidence in the output, they will not put in the extra effort required to ensure a high-quality input. The end result will be an aborted ADP conversion and potential business disaster.

Summary

It's been a long trip through the quality assurance tree, and we have taken a number of side trips to explore specific branches of our tree. When evaluating the software, do not lose sight of your primary goals. Continually ask yourself, will this package satisfy my stated requirements? Will it operate reliably in the applications environment? Can I afford to own it? In short, does the software have direct utility and is it maintainable? ■

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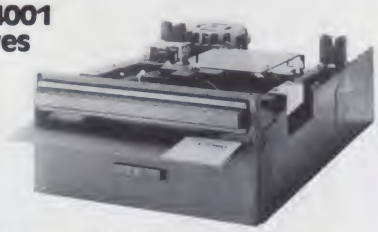
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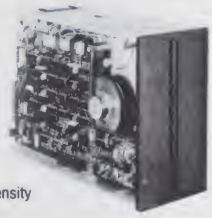
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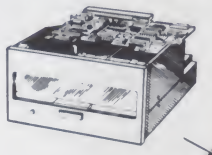


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RELDMP

For Motorola 6800 memory dumps in hex or ASCII.

Listing 1. RELDMP.

```
00010                    NAM    RELDMP   RELOCATABLE DUMP
00020                * SSC
00030                    OPT    O,S,G,P
00040                * RELOCATABLE MEMORY DUMP
00050                * USES MIKBUG SUBROUTINES AND
00060                * 4 BYTES OF RAM AT $A002
00070                *
00080                * MIKBUG INTERFACE
00090       A002     RAM    EQU    $A002
00100       E047     BADDR  EQU    $E047
00110       E1AC     INEEE  EQU    $E1AC
00120       E1D1     OUTEEE EQU    $E1D1
00130       E0E3     MIKBUG EQU    $E0E3
00140       E0CA     OUT2HS EQU    $E0CA
00150       E0C8     OUT4HS EQU    $E0C8
00160                *
00170 2D00           ORG    $2D00
00180       2D00     RELDMP EQU    *
00190 2D00 5F        CLR B                  CLEAR OPTIONS
00200 2D01 86 48     LDA A  #'H
00210 2D03 8D 72     BSR    PPGI
00220 2D05 26 02     BNE    NOHEX
00230 2D07 C6 80     LDA B  #$80
00240 2D09 86 41     NOHEX  LDA A  #'A      ASCII?
00250 2D0B 8D 6A     BSR    PPGI
00260 2D0D 26 01     BNE    NOASCI
00270 2D0F 5C        INC B
00280 2D10 5D        NOASCI TST B
00290 2D11 26 03     BNE    DOIT
00300 2D13 7E E0E3   JMP    MIKBUG  NOTHING TO DO
00310 2D16 86 53     DOIT   LDA A  #'S      START ADDR
00320 2D18 8D 68     BSR    PPGH
00330 2D1A FF A002   STX    RAM     START
00340 2D1D 86 45     LDA A  #'E     END ADDR
00350 2D1F 8D 61     BSR    PPGH
00360 2D21 FF A004   STX    RAM+2   END
00370 2D24 CE A002 PRNTAD LDX  #RAM
00380 2D27 BD E0C8   JSR    OUT4HS  ADDRESS
00390 2D2A FE A002   LDX    RAM
00400 2D2D 5D        TST B
00410 2D2E 2A 11     BPL    PRNA
00420                * PRINT HEX
00430 2D30 37        PSH B                  SAVE OPTIONS
00440 2D31 C6 10     LDA B  #16     COUNT
00450 2D33 FE A002   LDX    RAM
00460 2D36 BD E0CA PHLUP JSR    OUT2HS
00470 2D39 5A        DEC B
00480 2D3A 26 FA     BNE    PHLUP   LOOP UNTIL PRINTED
00490 2D3C 33        PUL B
00492 2D3D 86 20     LDA A  #'      SPACE
00494 2D3F BD 33     BSR    OUT
00500 2D41 C5 01     PRNA   BIT B  #1       ASCII PRINT?
00510 2D43 27 18     BEQ    NPASC   NO
00515                * PRINT ASCII
00520 2D45 37        PSH B
00530 2D46 C6 10     LDA B  #16     COUNT
00540 2D48 FE A002   LDX    RAM     GET START ADDR
00550 2D4B A6 00     PALUP  LDA A  0,X      GET CHAR
00560 2D4D 84 7F     AND A  #$7F    CLEAR H.O. BIT
00570 2D4F 81 7F     CMP A  #$7F    DELETE?
00580 2D51 27 04     BEQ    CCHR    YES - ? IT
00590 2D53 81 20     CMP A  #$20    CONTROL CHAR?
00600 2D55 2A 02     BPL    GOODC   NOT CC
00610 2D57 86 3F     CCHR   LDA A  #'?      PRINT ? FOR CONTROLS
00620 2D59 8D 19     GOODC  BSR    OUT     PRINT
00630 2D5B 08        INX
00640 2D5C 5A        DEC B
```

This article deals with RELDMP, a relocatable memory dump program designed for the Motorola 6800 processor. It is one of those easy, straightforward programs that we need but never find the time to write. I had been busy developing a disk-operating system using the M command of MIKBUG to display parts of memory. I finally realized I was wasting more time displaying memory this way than it would take to write a dump program.

RELDMP displays 16 bytes per line in hex, ASCII or both. Each line is preceded by the address of the first byte of the line. The program uses relative addressing so that it can be moved anywhere in memory. It requires 99 (hex) bytes of memory plus locations A002 through A005 in the MIKBUG RAM.

To execute RELDMP, load it and start execution at RELDMP. It will prompt with H>. To display in hexadecimal, enter Y; otherwise, enter any other character. RELDMP will next prompt with A>. To convert to ASCII, enter Y; otherwise, enter any other character. If you answer Y to both the H> and A> prompts, the dump will be printed in both hexadecimal and ASCII.

The next prompt is S>. Enter the first address to be dumped, and enter the last address in response to E>. RELDMP will dump the specified locations and return to the H> prompt. Answering other than Y to both the A> and H> prompts will cause RELDMP to return to MIKBUG.

If you wish to relocate RELDMP, simply enter a se-

```
00010                    NAM    MOVEDUMP
00015                    OPT    O,G,P,S
00020 0100               ORG    $100
00030 0100 CE 2D00 START LDX    #$2D00  START
00040 0103 8C 2DA0       CPX    #$2DA0  ARE WE DONE YET?
00050 0106 27 11         BEQ    OUT     YES - TERMINATE
00060 0108 A6 00         LDA A  0,X     GET BYTE
00070 010A 08            INX            INCREMENT POINTER
00080 010B FF 0101       STX    START+1 SAVE ADDRESS OF NEXT BYTE
00090 010E CE 1000 NEW   LDX    #$1000  ADDRESS TO MOVE TO
00100 0111 A7 00         STA A  0,X     SAVE BYTE
00110 0113 08            INX            INCREMENT TO POINTER
00120 0114 FF 010F       STX    NEW+1   SAVE TO ADDRESS
00130 0117 20 E7         BRA    START   GET NEXT BYTE
00140 0119 3F       OUT  SWI            ALL DONE
00150                    END
START  0100
NEW    010E
OUT    0119
```

Listing 2.

```
00650 2D5D 26 EC          BNE    PALUP    LOOP UNTIL DONE
00660 2D5F 33             PUL B
00670      2D60    NPASC  EQU    *
00680 2D60 FF A002        STX    RAM
00690 2D63 8D 28          BSR    CRLF
00700                * MORE TO DO?
00710 2D65 CE A002        LDX    #RAM
00720 2D68 A6 01          LDA A  1,X      L.O. OF CURRENT
00730 2D6A A0 03          SUB A  3,X      L.O. OF LAST
00740 2D6C A6 00          LDA A  0,X      H.O. OF CURRENT
00750 2D6E A2 02          SBC A  2,X      H.O. OF LAST
00760 2D70 2B B2          BMI    PRNTAD   PRINT NEXT LINE
00770 2D72 20 8C          BRA    RELDMP   START OVER
00780                *
00790 2D74 7E E1D1 OUT    JMP    OUTEEE
00800                * PRINT, PROMPT, & GET INPUT
00810      2D77    PPGI   EQU    *
00820 2D77 8D FB          BSR    OUT
00830 2D79 86 3E          LDA A  #'>
00840 2D7B 8D F7          BSR    OUT      PROMPT
00850 2D7D BD E1AC        JSR    INEEE
00860 2D80 20 0B          BRA    CRLF
00870      2D82    PPGH   EQU    *        GET HEX
00880 2D82 8D F0          BSR    OUT
00890 2D84 86 3E          LDA A  #'>
00900 2D86 8D EC          BSR    OUT
00910 2D88 37             PSH B           SAVE OPTIONS
00920 2D89 BD E047        JSR    BADDR    GET HEX
00930 2D8C 33             PUL B           RESTORE OPTIONS
00940      2D8D    CRLF   EQU    *        ISSUE CR AND LF
00950 2D8D 36             PSH A
00960 2D8E 86 0D          LDA A  #$D
00970 2D90 8D E2          BSR    OUT
00980 2D92 86 0A          LDA A  #$A
00990 2D94 8D DE          BSR    OUT
01000 2D96 32             PUL A
01010 2D97 81 59          CMP A  #'Y
01020 2D99 39             RTS
01030                *
01040 A048                ORG    $A048
01050 A048 2D00           FDB    RELDMP   SET P
01060                     END
RAM    A002
BADDR  E047
INEEE  E1AC
OUTEEE E1D1
MIKBUG E0E3
OUT2HS E0CA
OUT4HS E0C8
RELDMP 2D00
NOHEX  2D09
NOASCI 2D10
DOIT   2D16
PRNTAD 2D24
PHLUP  2D36
PRNA   2D41
PALUP  2D4B
CCHR   2D57
GOODC  2D59
NPASC  2D60
OUT    2D74
PPGI   2D77
PPGH   2D82
CRLF   2D8D
```

quence to load and store the program in a new location. For example, the program shown in Listing 2 will relocate RELDMP from $2D00 to $1000.

For anyone wishing to use RELDMP with a monitor other than MIKBUG (or the SWTP SWTBUG monitor, which is MIKBUG compatible), the following is an explanation of the MIKBUG subroutines used:

△BADDR—Return a four-digit hexadecimal number input from the terminal in the X register.

△INEEE—Get one ASCII character from the terminal.

△OUTEEE—Output one ASCII character to the terminal.

△MIKBUG—Return to the monitor.

△OUT2HS—Output the byte pointed to by X in hexadecimal, followed by a space.

△OUT4HS—Output the two bytes pointed to by X in hexadecimal, followed by a space.■

```
$L
$G H>Y
A>Y
S>1CF0
E>1D27
1CF0 20 42 52 41 20 53 54 41 52 54 20 47 45 54 20 4E   BRA START GET N
1D00 45 58 54 20 42 59 54 45 04 30 31 34 30 20 4F 55  EXT BYTE?0140 OU
1D10 54 20 53 57 49 20 41 4C 4C 20 44 4F 4E 45 04 30  T SWI ALL DONE?0
1D20 31 35 30 20 20 45 4E 44 04 C1 20 20 20 20 20 FF  150  END?A      ?
H>Y
A>N
S>1CF0
E>1D27
1CF0 20 42 52 41 20 53 54 41 52 54 20 47 45 54 20 4E
1D00 45 58 54 20 42 59 54 45 04 30 31 34 30 20 4F 55
1D10 54 20 53 57 49 20 41 4C 4C 20 44 4F 4E 45 04 30
1D20 31 35 30 20 20 45 4E 44 04 C1 20 20 20 20 20 FF
H>N
A>Y
S>1CF0
E>1D27
1CF0  BRA START GET N
1D00 EXT BYTE?0140 OU
1D10 T SWI ALL DONE?0
1D20 150  END?A      ?
H>N
A>N
```

Test execution of RELDMP.

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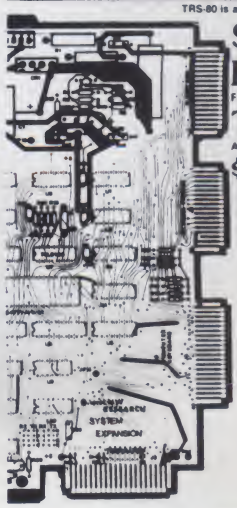
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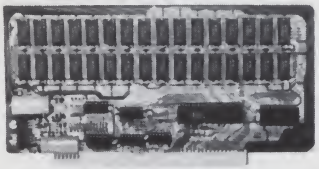
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Cook's Memory Test For the 6502

Version 3 of this test follows two others: one for the KIM, one for the 8080.

Fred Monsour
309 Camellia Drive
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Whether you built your system chip by chip or bought it fully assembled, you've probably had, or at least worried about, memory problems. There was a time—before I stabilized my KIM-1 expansion—when I collected memory tests as some people collect stamps.

Unfortunately, that didn't deter the memory bugs, which crept in just as I was about to save a 200-line program or show my latest software acquisition to some innocent bystander. Worst of all was the feeling that I had wasted my time and money on a computer that couldn't be trusted.

About the time I was considering computercide, Charles Cook published his "walking bit" test routine ("Memory Troubleshooting Techniques," *Kilobaud*, Oct. 1977, p. 58). That looked like KIM's salvation, but since my machine-language programming expertise extended to adding two hexadecimal numbers, I waited for someone else to put it into code. By the time Rod Hallen's 8080 version appeared a few months later ("It's Here: Cook's Memory Test," *Kilobaud*, July 1978, p. 70), I had progressed to adding *three* hexadecimal numbers together.

So after seeing how well the routine had worked for Rod, I decided to try a 6502 version. Cook's algorithm unearthed several rambunctious 2102s, which had been given A-1 ratings by other memory tests minutes earlier. Since I replaced those, my system's been almost 100 percent reliable. At least now I'm confident that if bad memory is the problem, I'll know about it.

The program listing given here is slightly modified from my original code in order to make the program more portable. At a small sacrifice in size, I have used only one subroutine from the KIM monitor—OUTCH, which prints the character in the accumulator. If you use a different output routine, no registers need be preserved.

It tests 8K of RAM in less than 3 seconds, so I let it cycle several times to be sure all is well. At the end of each cycle it prints an asterisk to let you know it's making progress.

The flowchart in Fig. 1 is similar to those presented in the articles by Cook and Hallen. I won't go into the logic of the algorithm any further; refer to the previous articles for a complete discussion. Generally, though, an error at branch A indicates a byte that can't have all 0s stored in it. Error B usually is due to shorted or open address lines, while error C is due to shorted or open input data lines. Error D signifies a byte that can't store all 1s.

No memory test is perfect, but this is one of the best. Add it to your arsenal and be prepared when memory bugs strike. ■

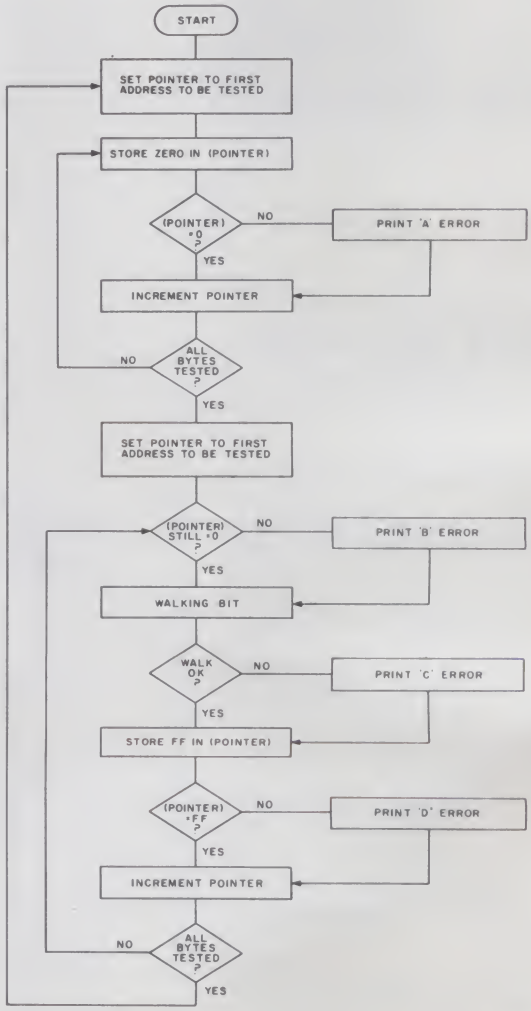


Fig. 1. Program flowchart.

Program listing. To use the program, put the first address to test in locations 0000/0001, the last address to test + 1 in 0002/0003. Start the program running at address 0200.

```
0010: 0200                    ORG    $0200
0020:
0030:                  ************************************
0040:                  *                                  *
0050:                  *  COOK'S MEMORY TEST FOR THE 6502 *
0060:                  *          BY FRED MONSOUR         *
0070:                  *                                  *
0080:                  ************************************
0090:
0100:
0110: 0200             POINTL *      $00FA
0120: 0200             POINTH *      $00F8
0130: 0200             START  *      $0000
0140: 0200             END    *      $0002
0150: 0200             OUTCH  *      $1EA0    KIM SUB TO PRINT CHAR IN ACCUMULATOR
0160: 0200             TEMP   *      $00FC
0170:
0180: 0200 20 5D 02  BEGINA JSR    INIT     SET POINTERS TO FIRST TEST ADDRESS
0190:
0200:                   ** TEST FOR STORING ALL ZEROS **
0210: 0203 A9 00       NEXTA  LDAIM $00      TEST PROBE = 00
0220: 0205 A8                 TAY            ZERO Y-INDEX
0230: 0206 91 FA              STAIY POINTL   STORE ZERO IN TEST ADDRESS
0240: 0208 B1 FA              LDAIY POINTL   GET IT BACK
0250: 020A F0 05              BEQ   INCA     IF STILL ZERO MOVE ON
0260: 020C A2 41              LDXIM 'A       ELSE ERROR CODE = A
0270: 020E 20 66 02           JSR   ERR      PRINT THE BAD NEWS
0280: 0211 20 89 02  INCA     JSR   INC      POINT TO NEXT ADDRESS
0290: 0214 20 80 02           JSP   COMPR    SEE IF DONE WITH FIRST PASS
0300: 0217 90 EA              BCC   NEXTA    IF NOT, TEST NEXT ADDRESS
0310:
0320:                   ** TEST FOR RETAINING ZEROS **
0330: 0219 20 5D 02           JSR   INIT     RESET POINTER FOR SECOND PASS
0340: 021C B1 FA       BEGINB LDAIY POINTL   SEE IF ZERO STILL THERE
0350: 021E F0 05              BEQ   WALK     YES: DO NEXT TEST
0360: 0220 A2 42              LDXIM 'B       NO: ERROR CODE = B
0370: 0222 20 66 02           JSR   ERR      PRINT THE BAD NEWS
0380:
0390:                   ** WALKING BIT TEST **
0400: 0225 A2 08       WALK   LDXIM $08      BIT COUNTER = 8
0410: 0227 A9 01              LDAIM $01      PROBE FIRST BIT
0420: 0229 91 FA       NEXTB  STAIY POINTL   STORE BIT IN TEST ADDRESS
0430: 022B D1 FA              CMPIY POINTL   STORED OK?
0440: 022D F0 0D              BEQ   SHIFT    YES: DO NEXT BIT
0450: 022F 9A                 TXS            NO: SAVE BIT COUNTER...
0460: 0230 48                 PHA            AND TEST PROBE...
0470: 0231 8A                 TXA            GET BAD BIT # (COUNTING FROM LEFT)
0480: 0232 20 94 02           JSR   PRBYT    PRINT IT...
0490: 0235 68                 PLA            RESTORE TEST PROBE
0500: 0236 A2 43              LDXIM 'C       ERROR CODE = C
0510: 0238 20 66 02           JSR   ERR      PRINT THE BAD NEWS
0520: 023B BA                 TSX            RESTORE BIT COUNTER
0530: 023C 0A          SHIFT  ASLA           NOW SHIFT PROBE TO NEXT BIT...
0540: 023D CA                 DEX            ONE LESS BIT LEFT TO TEST
0550: 023E D0 E9              BNE   NEXTB    FINISH ALL 8 BITS
0560:
0570:                   ** TEST FOR STORING ALL ONES **
0580: 0240 A9 FF              LDAIM $FF      TEST PROBE = FF
0590: 0242 91 FA              STAIY POINTL   STORE FF IN TEST ADDRESS
0600: 0244 D1 FA              CMPIY POINTL   STORE OK?
0610: 0246 F0 05              BEQ   INCB     YES: MOVE ON
0620: 0248 A2 44              LDXIM 'D       NO: ERROR CODE = D
0630: 024A 20 66 02           JSR   ERR      PRINT THE BAD NEWS
0640: 024D 20 89 02  INCB     JSR   INC      POINT TO NEXT ADDRESS
0650: 0250 20 80 02           JSR   COMPR    SEE IF DONE WITH SECOND PASS
0660: 0253 90 C7              BCC   BEGINB   IF NOT, TEST NEXT ADDRESS
0670: 0255 A9 2A              LDAIM '*       IF SO, PRINT '**...
0680: 0257 20 90 02           JSR   PRNT     TO SAY SO
0690: 025A 4C 00 02           JMP   BEGINA   AND DO WHOLE THING AGAIN
0700:
0710:                   ** SUBROUTINES **
0720: 025D A5 00       INIT   LDAZ  START    PUT LSB OF START ADDRESS...
0730: 025F 85 FA              STA   POINTL   IN LSB OF POINTER
0740: 0261 A5 01              LDAZ  START+01 PUT MSB OF START ADDRESS...
0750: 0263 85 FB              STA   POINTH   IN MSB OF POINTER
0760: 0265 60                 RTS            RETURN
0770:
0780: 0266 48          ERR    PHA            SAVE TEST PROBE
0790: 0267 98                 TYA            SAVE Y-INDEX
0800: 0268 48                 PHA
0810: 0269 8A                 TXA            GET ERROR CODE
0820: 026A 20 90 02           JSR   PRNT     PRINT IT
0830: 026D A5 FB              LDA   POINTH   GET MSB OF BAD ADDRESS
0840: 026F 20 94 02           JSR   PRBYT    PRINT IT
0850: 0272 A5 FA              LDA   POINTL   GET LSB OF BAD ADDRESS
0860: 0274 20 94 02           JSR   PRBYT    PRINT IT
0870: 0277 A9 20              LDAIM $20      GET ASCII SPACE
0880: 0279 20 90 02           JSR   PRNT     PRINT IT
0890: 027C 68                 PLA            RESTORE...
0900: 027D A8                 TAY            Y-INDEX
0910: 027E 68                 PLA            RESTORE TEST PROBE
0920: 027F 60                 RTS            RETURN
0930:
0940: 0280 A5 FA       COMPR  LDA   POINTL   THIS ROUTINE CLEARS CARRY FLAG...
0950: 0282 C5 02              CMP   END      IF POINTER < END ADDRESS
0960: 0284 A5 FB              LDA   POINTH   ELSE SETS IT
0970: 0286 E5 03              SBC   END
0980: 0288 60                 RTS
0990:
1000: 0289 E6 FA       INC    INC   POINTL   THIS ROUTINE...
1010: 028B D0 02              BNE   RET      INCREMENTS POINTER
1020: 028D E6 FB              INC   POINTH   (EQUIV. OF KIM INCPT)
1030: 028F 60          RET    RTS
1040:
1050: 0290 20 A0 1E    PRNT   JSR   OUTCH    KIM SUB TO PRINT CHAR IN ACCUM.
1060: 0293 60                 RTS
1070:
1080: 0294 85 FC       PRBYT  STA   TEMP     THIS ROUTINE BREAKS...
1090: 0296 4A                 LSRA           BYTE IN HALF AND
1100: 0297 4A                 LSRA           PRINTS EACH HALF AS ASCII CHAR
1110: 0298 4A                 LSRA           (EQUIV. OF KIM PRTBYT)
1120: 0299 4A                 LSRA
1130: 029A 20 A5 02           JSR   HEXASC
1140: 029D A5 FC              LDA   TEMP
1150: 029F 20 A5 02           JSR   HEXASC
1160: 02A2 A5 FC              LDA   TEMP
1170: 02A4 60                 RTS
1180:
1190: 02A5 29 0F       HEXASC ANDIM $0F      THIS ROUTINE CONVERTS...
1200: 02A7 C9 0A              CMPIM $0A      HEX DIGIT TO ASCII
1210: 02A9 18                 CLC            (EQUIV. OF KIM HEXTA)
1220: 02AA 30 02              BMI   HEXASD
1230: 02AC 69 07              ADCIM $07
1240: 02AE 69 30              ADCIM $30
1250: 02B0 4C 90 02           JMP   PRNT

SYMBOL TABLE
BEGINA 0200    BEGINB 021C    COMPR  0280    END    0002
ERR    0266    HEXASA 02AE    HEXASC 0285    INCA   0211
INCB   024D    INC    0289    INIT   025D    NEXTA  0203
NEXTB  0229    OUTCH  1EA0    POINTH 00F8    POINTL 00FA
PRBYT  0294    PRNT   0290    RET    028F    SHIFT  023C
START  0000    TEMP   00FC    WALK   0225
```

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Will visit London, Paris, and Munich Electronica '80 from October 29th to November 9th, 1980.

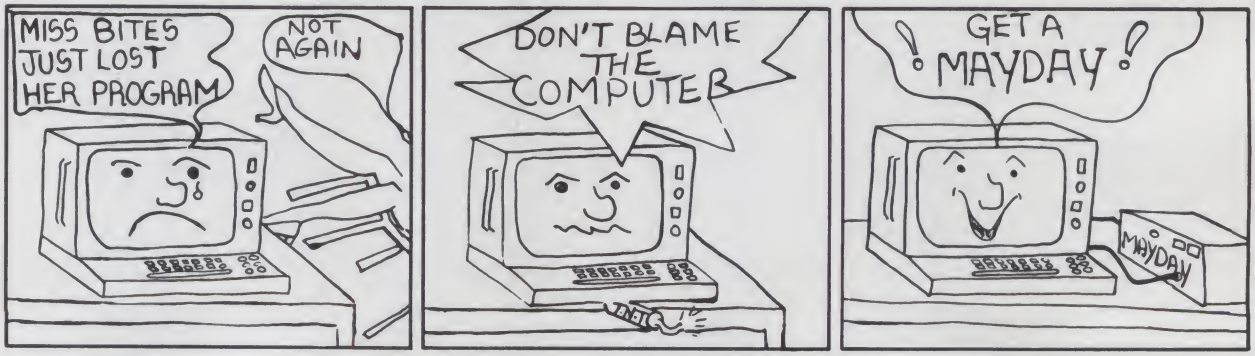
As described by Wayne Green in January, Feb. 1980 73 Magazine

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An Introduction to Small Business Software for the PET*. II.

Can DR. DALEY's offer a better Mailing List Maintenance System?

You've seen them all! Every software supplier offers a mailing list system of some sort or another. Each of them has some advantages and some disadvantages over the others.

So when DR. DALEY's decided to offer a mailing list we felt that it had to offer some other advantages over all of the others. We have offered—and sold some—mailing list systems before, but these offer few things that makes them unique.

SERIOUS BUSINESS

When you wish to purchase a software system for any business purpose you need to give it serious and thorough consideration. What do you wish to accomplish with the software? What are your needs? How can a computer assist you in filling these needs? We have asked these questions numerous times to people who do mailings with lists in the size range of 500 to 15,000 names. The result was unanimous: everyone has different information needs. This, of course, means that everyone who buys a mailing list system, or any other business software, must find a program that comes closest to his needs. This is a time consuming, expensive task. We've talked with businessmen who have become frustrated with this process and are ready to throw in the towel. Another option is to hire a programmer to write the software for you or to write your own. This can cost more than the cost of the computer.

The last option is to find prepackaged software which each individual user can easily configure to his own needs. This would allow each business to customize its own computer maintained mailing list files to, as closely as is possible, parallel the current mailing list operation. Until now, this option has been virtually impossible to fulfill, from any software publisher.

IMPLEMENTATION

Our computerized mailing list system is designed to be easy for you, the user, to be able to easily configure your files to contain information in much the same way as you currently are doing. This means less of the pain and anguish that frequently accompanies computerization.

During the programming the author was in frequent contact with potential end users. The main thought during the development phase was to make the operation easy to understand, yet powerful enough to handle the job. Give the user as many options as is feasible, with the flexibility to make the greatest possible use of the file information. Finally, be sure that the capacity of the system is sufficient to allow most any business to make use of it.

The final version will allow records of 117 USABLE characters in length with a maximum of 15 fields within each record. It also allows reasonably large capacity with multiple diskette (maximum of 100 diskettes on a 32K PET or CBM) files and up to 1340 records per diskette.

WHAT ABOUT SORTING?

We hear this question most frequently from you. This is because sorting is the operation that divides the MAILING LIST system from any mailing list system. Why sorting? Well it is the way that the user can do such things as selective mailings to groups with common characteristics. This could include regional mailings, mailings to customers of a particular product, mailings to purchasers or to prospective customers, etc., etc. Or you might wish to make any possible combination of these categories.

Try to do this on most ordinary mailing list programs. You simply can't do it with most of the offerings on the market today.

This sorting is done by a "wild card" type of sort. This means that you can specify the contents of any portion of a field for a match and the computer will take any match for the rest of the field. This type of sort is best illustrated with the following examples:

A sort key can be: **R**1
Matches with FORT#1
and T4R321
and %/R@31

Our system allows this type of sorting using up to three fields within each record. Thus you should be able to retrieve almost any conceivable subset of the files.

File organization is done using two of the fields as sort keys. This again is user selectable. You could, for example, specify that you wish the file to be in ZIP CODE sequence or in alphabetical sequence and all records within the file will be sequenced with that field. There is also a second sort field which is used to sequence the file where the first field is the same.

WHAT ABOUT LABELS?

We hear this one almost as often as the sorting. Well, here this is up to you. You can, at the time you print labels, choose the layout of the labels, you can also choose the number of labels per line. If you wish to have a four line address and printed four records wide you can do it.

WHAT ABOUT EDITING?

Editing is accomplished at several points in the program. These are at the time of entry, before saving the records to the file and from the disk file. You can easily modify any record at any of these points.

This does not really cover all of the operations on the files. Space simply does not allow a more complete description of the user oriented approach of the program.

We asked the question: Can we offer a better mailing list system? You bet we can! It's here now.

HARDWARE REQUIREMENTS

At present this requires a Commodore PET or CBM computer with a dual disk drive and a printer. It is set up to work with the Commodore printer or with most any other printer. Watch for these programs to be introduced for use with other types of popular microcomputers. The APPLE II version will be available about June 1, 1980. Watch for it!

ORDERING

At the present time many Commodore dealers do not carry our software. Thus you will most likely need to either persuade them to order for you or calling us directly at (616) 471-5514 anytime between noon and 9 p.m. Eastern time Sunday through Thursday. For only $99.95 plus four percent tax in the state of Michigan, you get this powerful, field tested, fully documented program packaged in a convenient three-ringed binder.

INVENTORY

We must add this note. There is too little space to allow us to describe the INVENTORY system adequately here. It offers the same flexibility as does the MAILING LIST described above, but we can't *tell you much* more. Write or call for details. It also is priced at $99.95.

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*Watch for it on the APPLE II.

↙Reader Service—see page 257

Living with Cassettes

This is one way to survive until you get your disk.

Josef Bernard
139 Ridge Park Ave.
Stamford CT 06905

Are you still having problems loading software into your computer from cassettes? Whose fault is it, anyway? The tendency is to blame the difficulty on the cassette, on the recorder or on the computer.

I've been dealing with microcomputers and cassettes for several years and have found that most of the supposedly defective cassettes can be loaded easily enough if the right approach is taken. There are times when the cassette really does have something wrong with it, or the recorder is out of whack, or a chip has gone in the computer. In most cases, the problem is due to the user's unfamiliarity with what's involved in getting a program onto and off a cassette.

Whether you cannot load prerecorded programs or cannot get back from the tape programs you write and save yourself, the major factor behind the difficulty is that the computer is not "hearing" the kind of signal it needs to hear in order to read the program properly.

The Other Guy's Recordings

Let's look at what happens when audio-encoded digital information is transferred to tape. If you have access to an oscilloscope and can observe the waveforms of the audio signals produced by your computer when generating the signal intended for the cassette recorder—and can then watch these same signals as reproduced from the recorded tape—you will see a significant difference between the two, supposedly identical, waveforms (Fig. 1).

The audio signal your computer generates is close to being a square wave, which is the ideal way to represent digital data (the level is either high or low; there's no in-between). Due to the restrictions of the magnetic medium, however, particularly with inexpensive portable recorders, that beautiful wave-



Fig. 1. A true square wave and sine wave (first two drawings) vs the cassette recorder's idea of a square wave.

form is distorted considerably and loses definition. It stops being a square wave and becomes more nearly a sine wave with no clearly defined transition between high and low.

This transition is just the sort of information your computer is looking for. You are lucky to get out a reasonable approximation of what you put in. To minimize distortion inherent in the system and the chaos it can wreak in your computer, you need all the control you can get!

In the playback mode, the recorder's tone control permits you to minimize distortion at the high end of the frequency spectrum (by not turning the control all the way up) and also allows you to possibly reinforce some of the low end by increasing the bass response (or, more realistically, on most recorders, by decreasing the treble). A little experimentation will allow you to find your system's happy medium.

Part of the tone-optimization problem may be due to the fact that the record head on the recorder used to produce the other guy's tape and the playback head on your equipment may not be precisely aligned with one another. If you are having problems with a tape produced by a professional outfit, the difficulty almost certainly lies at your end.

There are two possible remedies. If the head alignment is not too far off, you may be able to get a reasonable reproduction of the signal by adjusting the tone control as discussed above. If this proves impossible, you will have to adjust the azimuth (elevation) of your playback head to bring it into alignment with that of the original recording equipment.

There are two ways to make the azimuth adjustment. Listen to the audio signal and adjust the azimuth of the playback head to produce the least muddy-sounding audio. Adjust it by turning the Phillips-head screw that tensions a spring and is visible when you have the recorder in the play or record mode. As you play a tape and adjust this screw, you can hear the sound going from muddy to brilliant, back again, and then, if you continue turning, dropping off considerably. The optimum point is usually close to the most brilliant sound.

A more professional method is to use a peak reading voltmeter (the Model PK-80, together with an alignment tape and adjustment tool, is available from Cook Laboratories, 375 Ely Ave., Norwalk CT 06854, for $49.50), which allows you to adjust the azimuth by watching for the maximum signal output.

If possible, you should use an alignment tape made especially for this purpose. These tapes are calibrated to standards used throughout the audio industry and will allow you to bring your equipment into line with that used to record your problem cassette. This means that all the programs you have written will be slightly out of whack with respect to this new alignment, but there is a good chance that you will be able to read them back again since you probably were not that far off.

Once you have aligned your head, load and then rerecord these programs so that all of your tapes will conform to the same standard.

If the playback level is too low, the computer will not hear the data at all. At the other end of the scale—despite the manufacturer's claims as to the flex-

ibility of the computer—a setting that is too high will overload the computer's input circuitry and will show distortion on the scope, particularly in the form of flat-topping or clipping (losing the loudest parts of the program simply because they are too loud for the amplifier section to handle). This *overloading* can also add distortion products to the signal, which means that you are actually generating signals "from out of nowhere" that the computer has no idea what to do with.

Most computers work well with a reasonably low amplitude (to the ear) signal. If it's comfortable for you to listen to through the recorder's speaker, it's probably fine for the computer, too.

Phase distortion occurs quite frequently in cassette systems (and larger ones, too) and is particularly dangerous to computers that must know whether they are seeing the beginning or end (leading or trailing edge) of a sine (or square) wave and that become confused if they see an unclear jumble of semi-sine waves.

Phase distortion most frequently occurs when a program is transferred from the master tape to cassette by strictly audio means—without being loaded into a computer and then saved from it as a series of true square waves. If one recorder can distort a signal badly enough to make it unreadable, imagine what two recorders can do together!

There's little you can do to try to correct phase distortion, and, should you have a bad cassette and exhaust all the other possibilities beyond a reasonable doubt, you should ask for a replacement from the dealer.

If you are forced to do a direct tape-to-tape audio transfer, the best way (although I offer no guarantee) to minimize phase distortion is to use a chromium-dioxide-type tape such as Crolyn. This tape has an extremely wide latitude, meaning that it takes an awful lot of signal just to start getting distortion, and gives you your best chance of getting out a reasonable facsimile of what you put in.

Chromium dioxide tapes are widely known for their excellent signal-to-noise ratio (very low hiss), but this is unimportant since any good-quality tape will suffice to enable a recorder to distinguish between data and background noise. These tapes offer the ability to "swallow" and faithfully reproduce signals that would overload and cause distortion in conventional ferric oxide tapes.

Always try to take the signal directly from the computer. It's the cleanest way and produces the best results with a minimum of difficulty.

Other Possibilities

In scrutinizing prerecorded cassettes, you should be certain to actually listen to the tape for faults that may have slipped past the manufacturer's quality control department. You may find that there is excessive hum riding along with the data. This will confuse the computer to no end. You may find that the audio is so low that you cannot increase it enough with the volume control to make the computer understand the program.

Some store-bought cassettes sound like old and much abused 78 RPM records. Occasionally, you may even buy a cassette that is completely blank! In such cases, get a replacement from your dealer.

If a tape sounds muddy, be certain that your recording head is properly aligned and clean.

Make sure that the erase and record/playback heads of your recorder and the capstan and pinch roller (Fig. 2) are free of oxide buildup and that the heads are demagnetized.

A cotton swab and isopropyl alcohol will do the cleaning job—it should be performed for every ten hours that the recorder is used—and, if you've neglected this chore, you may be surprised to see the garbage that winds up on the swab.

When cleaning, put the recorder in the record mode so that all the heads are exposed. Be sure no cassette is in place and depress the lever at the left rear of the cassette receptacle to defeat the write protect feature built into the recorder, so as to bring all the heads into a position where they may be easily reached. When cleaning the capstan and pinch roller, work from the right-hand side to avoid getting the cotton on the swab twisted around the capstan. If it does get caught, just stop the recorder to release the mechanism, permitting you to unravel the twisted strands.

It is also a good idea to lightly lubricate the capstan driveshaft about once a year with a drop of light oil. Be sure to remove any excess oil.

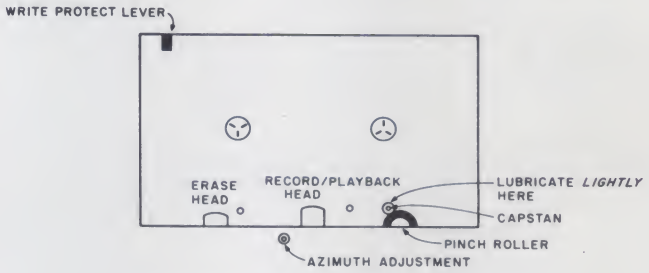


Fig. 2. Parts to clean on your recorder.

The cleaning will allow the tape to make better contact with the heads, and both the cleaning and lubrication will allow the recorder to run at a more constant speed.

Demagnetization, too, will improve the signal-to-noise ratio, but, more important for you, will restore the "highs" you may have been missing. Head demagnetizers, available for under $10, should be used at fairly frequent intervals. Be sure to follow the instructions and be absolutely certain to remove all recorded cassettes from the vicinity when using these devices since they'll demagnetize (or magnetize, depending on the circumstances) anything within their reach.

Listening

Most cassette interfaces work by decoding two tones—one high and one low. A properly recorded cassette sounds like a buzzsaw; what you're actually hearing is the rapid alternation between the two different tones. If there is distortion, you will, with practice, be able to detect it here, but the best place to listen is in the leader section of the tape—the single tone that precedes the program (and sometimes follows it).

This tone should sound absolutely pure. If you hear something besides a clear "beeeee . . . p" (perhaps two tones—one loud and one weak—simultaneously), there's something wrong. Something, somewhere, is distorting the signal, and it could be the amplifier section of the recorder. Turn down the volume a bit and listen again.

If the tone sounds cleaner, you've probably been trying to load the program at a too high level and you should now encounter little or no difficulty in making things work. If, however, the distortion is still apparent, then you either have a problem with the recorder or the tape really is bad and should be exchanged.

If you're using a computer whose recorder has no speaker, simply take the cassette in question and listen to it on a recorder that does have one. You'd be surprised at how many people don't think of this.

Your Own Recordings

While most complaints are about prerecorded cassettes, there are times when programs that you save yourself refuse to load back into the computer. Assuming that you are not having difficulties in loading tapes supplied by others, and that you are giving the computer the proper instructions for saving the programs, there remains one fairly common cause for this situation.

Most cassette recorders have two jacks for input. One is labeled "mike" or "mic" and is used for recording from weak signal sources such as a micro-

phone. The other is usually marked "aux" or "line" and is intended for recording high-level signals—generally from the output of another piece of audio equipment (such as an amplifier or another recorder) or from a computer.

While the strength of the signal output by a computer varies from machine to machine, it is almost always at line level—too loud for the mike input of the recorder. With one possible exception (the Apple II), you should use the "aux" or "line" input jack on the recorder for saving your programs.

Feeding a line-level signal into the mike input will overload the amplifier circuitry of the cassette recorder, even if it has some form of automatic level control (ALC).

It's easy enough to determine whether you've made the mistake of using the wrong input. Listen to the tape, particularly the leader tone. If it lacks the "purity" described earlier, you've almost certainly used the mike input by mistake and created a tape full of distortion, which is confusing your computer. Try it again using the "aux" input.

With some recorders, it's possible that, even if you are using the line input, you will also get input from the microphone. If this is the case, disable the mike input by putting a plug, with nothing attached to it, in the mike jack. In some cases, turning down the volume control will have the same effect.

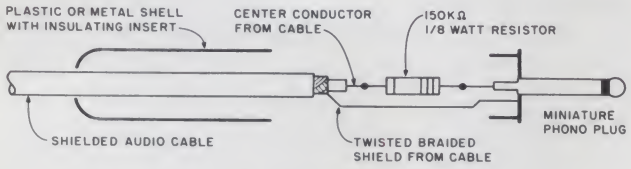


Fig. 3. Putting together a dropping cable.

Getting around ALC

Most cassette recorders of recent manufacture are equipped with ALC (automatic level control), which is intended to maintain a constant input to the recording circuitry, regardless of the varying volume level of the source material. In a portable recorder, ALC is considered so useful that many manufacturers resort to it exclusively and give you no manual means to control the level of the incoming signal.

Under normal circumstances, you would have no need to override the ALC, but, if you own a recorder that has only a mike input, you will probably be in trouble if you want to save programs using that machine. While ALC can compensate for a tremendous range of sound levels, the signal from your computer is even more than it was designed for, and you will wind up with an overload condition, leading to distortion.

If you find yourself in this situation, don't despair. There's a way out. It involves making up a dropping cable, which is an audio cable with a resistor in it to reduce the signal level to one that's acceptable to the recorder.

It is possible to buy ready-made dropping cables, but I've never found one that gives me the audio level I need. See Fig. 3 for details on how to put together such a cable yourself.

The value of the resistor will vary from computer to computer, but a good starting point is around 150k Ohms. Use a 1/8 Watt resistor for the easiest fit (although you could squeeze in a more readily available ¼ Watt) and make sure that the miniature connector has either a plastic shell or, if the shell is metal, that there is an insulating insert to prevent the resistor leads from shorting out to ground.

To determine the proper value of the resistor, insert it into the center conductor of the audio cable using short clip leads or alligator clips. Keep all leads as short as possible to avoid picking up hum. If your recorder has a recording level meter, a signal of the proper amplitude will cause the meter to read just below the red (overload) zone.

If you have no meter (even if you have one, you should try this), then plug an earphone into the earphone jack, sometimes labeled "monitor," of the recorder and listen to the audio quality of the signal you are recording. It should be reasonably loud, but not distorted. A little experimentation will get you into the ball park, and you can then make up a permanent version of the cable.

If you need to try other values, you should work in increments of 10 or 20k Ohms.

Conclusion

The most important point is to realize, as many people do not, that it is often easy to determine the status of a cassette just by listening to it. The human ear is a very sensitive instrument and, with a little training, can frequently determine, just by listening to a tape, whether it is faulty. Recording methods and standards have improved of late, but the first step in troubleshooting an uncooperative cassette is to listen to it.

If you have a problem or solution I have neglected to mention (and I'm sure there are many), write and let me know, but please enclose an SASE if you want a reply. ■

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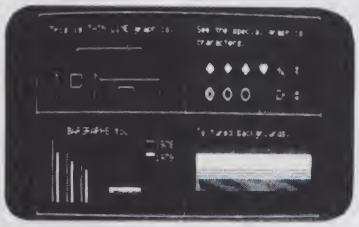
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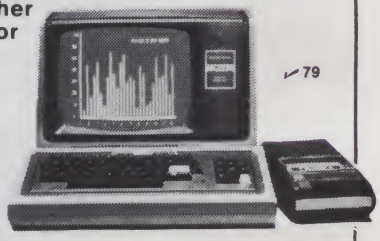
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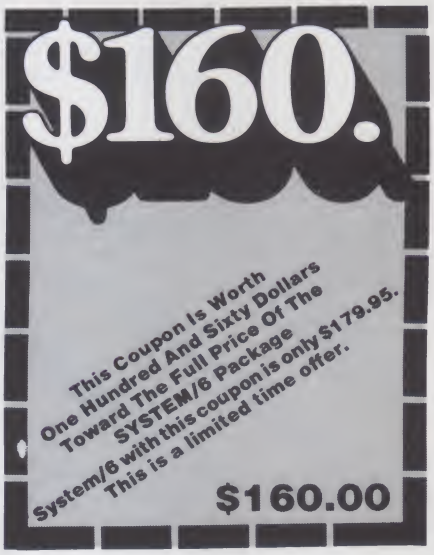
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A Hardware Calendar Clock for Your 6800

Time marches on, so keep track of it digitally—even when your computer is turned off.

Dexter S. French, Jr.
142 Stoney Ridge Dr.
Longwood FL 32750

This article describes a digital calendar clock with a battery backup, so that it will keep time even when the computer has been turned off. No interrupts are used, and the software is easily located in EPROM. The entire clock plugs into port 5 on the SS-50 bus and can be set like any digital clock. I will show you how to add the date and time to the TSC Assembler so they will be printed as part of the header on each page.

I chose to implement the calendar/clock function for my SWTP computer on a single I/O port where I could reach it if I had to set it. If I was going to set it, I should be able to see the display without resorting to mirrors. Therefore, I chose to build it on perfboard that was the same width as a regular I/O board (4.5 inches) but a bit higher (5.25 inches total) so I could see the display and operate the switches (see Photo 1).

The display is mounted in the upper left-hand corner, while the switches are mounted along the top. You can see the clock chip itself in the left middle, and the PIA is at the bottom, closest to the Molex connectors. The crystal-controlled oscillator is mounted in the lower right corner and drives the clock chip whether the power to the computer is off or on.

There are five other ICs on the board: the three ICs near the top drive the multiplexed display; the CD4050 directly above the time base oscillator drives the segment lines to the PIA; and the last IC, a CD4011 just to the left of the PIA, provides the gating for date and time selection under software control. The remaining headers contain the clamp circuits and current limiting resistors for the display.

I chose the CT-7001 clock chip because I had picked it up at a hamfest for $5, and it seemed to have all the features that I wanted. The display is a calculator display that I got from Poly-Paks. It was recently advertised for 2 for $1.29. It is actually a National NSA-1188 package of eight multiplexed 7 segment digits. I purchased the crystal time base as a kit (Quest, $4.95).

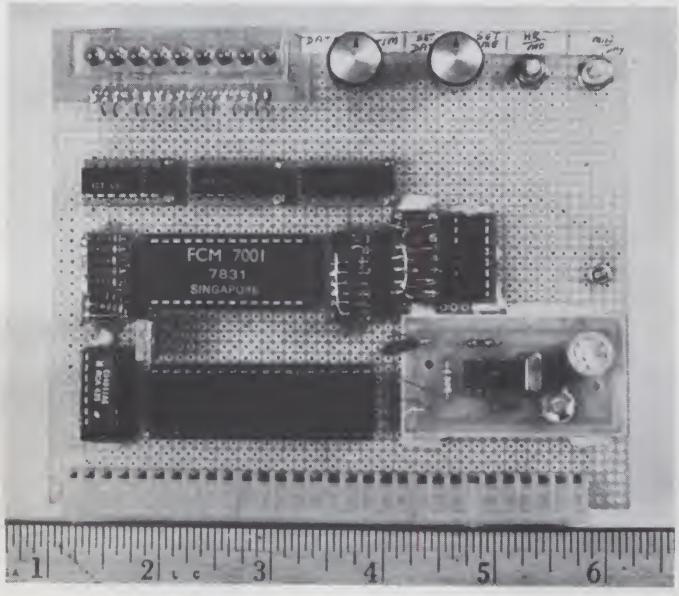


Photo 1. Hardware setup.

Hardware Design

The schematic of the clock is shown in Fig. 1. It shows a conventional clock built with a CT-7001 calendar/clock chip. The calendar and clock functions are manually accessed through hardware switches S1-S4. The clock portion of the hardware is the standard hookup for the CT-7001 clock chip. The PIA is interfaced to the clock with the clamp circuits consisting of two diodes and a 47k resistor. In my layout, I've put these on headers so that I can plug them into wire-wrap sockets on perfboard.

The PIA simply looks at the segment and digit lines on the CT-7001 clock chip. One line, CB2, switches the CT-7001 between its date and time functions.

Not all the segments are hooked to the PIA. Theoretically, we should be able to decode ten digits with no more than four bits, but the code of the 7 segments just would not cooperate. After trying several combinations of segments, I finally settled on 6. Maybe I just gave up too soon, but it just didn't seem worth further effort to save even one more bit. I had eight bits to work with anyway, so further reduction would save little.

I finally settled on the A,B,D,E,F and G segments. There are probably other combinations that would do as well; I just stopped looking when I found a workable combination. The six segments are interfaced to bits 0 through 5 of the A side of the PIA.

In addition, each of the six digits are interfaced to bits 0 through 5 of the B side. CB2 is the only output from the PIA and is used, along with the 4011 CMOS gate, to cause the clock chip to switch between displaying the date and the time. I built the required switching of the

clock functions with discrete parts. It just as easily could have been built with analog switches.

The battery backup is accomplished using the diode coupling of power to pin 1 of the clock chip. With the computer powered up, greater than 12 volts is delivered to pin 1 and pin 22 has power that enables the display. With power off, pin 22 is pulled low to disable the LEDs and save battery power. The crystal oscillator remains powered, as do the counters in the clock chip. Time marches on, but it isn't displayed when the computer is off.

To set the clock manually, place S2 in the SET CAL position. Then depress S3 to set the month and S4 to set the day of the month. With S2 in the SET CLOCK position, depress S3 to set the hour and S4 to set the minute (the seconds are reset to zero). When S2 is returned to the center off position, the clock will start. S1 examines the date and time manually. Leave S1 in the center position during computer access.

Software Interface

DATIME (DAte and TIME), the routine that reads the digits and decodes them to their ASCII equivalents, is shown in Listing 1. I wrote the program to be completely relocatable, except for SE6TAB at $E481, so you can move it to any convenient place. I chose port 5 for the clock in my system and placed the origin of the routine at $E400, where I have it in EPROM right after my EPROM version of SWTBUG. If you want to put the clock at a port other than 5, change locations $E407, $E44D, $E46A and $E47C accordingly.

Even though the program is full of comments, I will walk you through the program. RAM location $00D7 is in a buffer space that the TSC Assembler uses for titles it prints at the top of each page listing and is where an ASCII string of the date and time will be constructed. Next, the A and B sides of the PIA are initialized, and all bits are made inputs. CB2 is the output to control the date/time function of the CT-7001 clock chip. Since the date is read first, CB2 must be set to zero.

I've used a mask to de-multiplex the digits. Actually, the least significant bit (LSB) of the mask is the most significant bit (MSB) of the digits to be read. After a delay, the subroutine TDIG waits for the digit select line from the clock chip to match the particular digit in the mask. TDIG must find the digit five times in a row before deciding that it has a valid digit selected. This is a form of digital filtering, which I feel is one reason this clock has yet to come up with an incorrect digit.

Having found the proper digit in the mask, the LOOK loop exits to GOT, where we start the conversion of the segments into ASCII code. The $3F mask excludes bit 7 from the segment word.

Now, a byte-by-byte comparison is made of the segment table beginning at CONV, which keeps looping until a match is made. The address of the matched code is used to compute the ASCII code of the number. The lower eight bits of the address are taken and, after subtracting $30 for this particular table location, results in the ASCII equivalent code of the digit.

The simple arithmetic works

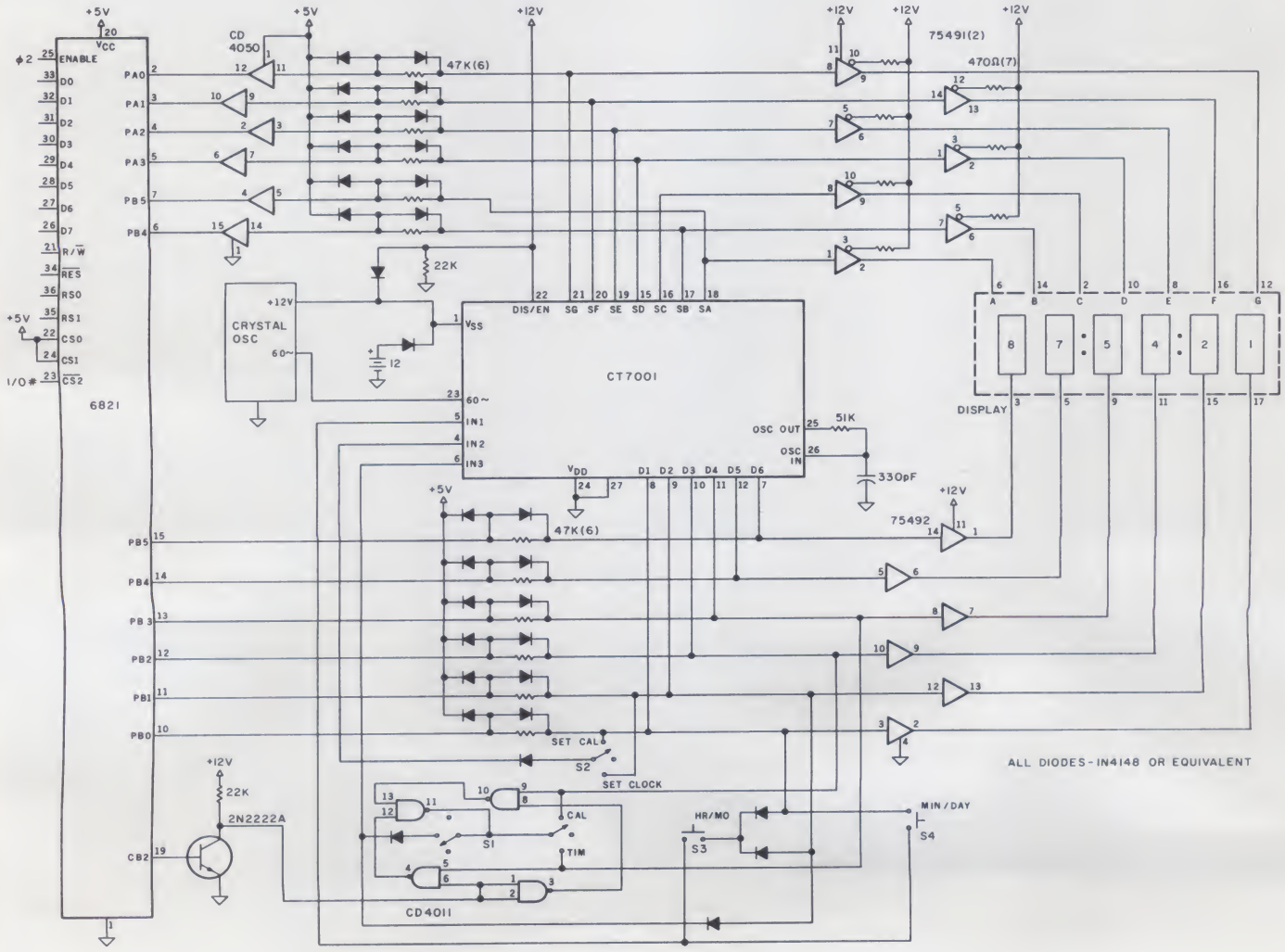


Fig. 1. Computer-clock circuitry.

```
                        NAM     DATIME
                        ********************************************************
                        *                  06/12/79
                        *            BY DEXTER S. FRENCH,JR.
                        *
                        * THIS PROGRAM READS A REAL TIME CLOCK PLUGGED INTO
                        * PORT 5 (8014) .  THE DATE AND TIME ARE OUTPUT.
                        *
                        *          COMPATIBLE WITH TSC ASSEMBLER
                        ********************************************************
8014                    PIAC    EQU     $8014
E1D1                    OUTEEE  EQU     $E1D1
00D7                    TYPMEM  EQU     $00D7     STRING POSITION
A015                    TYPBUF  EQU     $A015     POINTER TO STRING
A019                    NUBUF   EQU     $A019
A014                    MSKBUF  EQU     $A014
A017                    PRCNT   EQU     $A017
                        *
E400                            ORG     $E400
                                OPT     PAG
                        *
E400 CE 00 D7           DATIME  LDX     #TYPMEM
E403 FF A0 15                   STX     TYPBUF
E406 CE 80 14                   LDX     #PIAC     PLUGGED INTO PORT 5
E409 6F 01                      CLR     1,X       ALL A SIDE ARE INPUTS.
E40B 6F 00                      CLR     0,X
E40D 6F 03                      CLR     3,X       ALL B SIDE ARE INPUTS ALSO...
E40F 6F 02                      CLR     2,X
E411 86 37                      LDAA    #$37      CB2 IS OUTPUT FOR DATE/TIME
E413 A7 01                      STAA    1,X       CONTROL.
E415 A7 03                      STAA    3,X       CB2=0 FOR DATE
E417 86 02                      LDAA    #2        SET NUMBER OF DIGIT PAIRS FOR
E419 B7 A0 17                   STAA    PRCNT     DATE (2). DATE IS FIRST.
E41C 86 01                      LDAA    #$01      MASK FOR DIGIT SELECT
E41E B7 A0 14                   STAA    MSKBUF
E421 8D 72                      BSR     DELAY
E423 8D 4C              NXTDAT  BSR     TDIG      MSB OR TENS DIGIT OF PAIR
E425 78 A0 14                   ASL     MSKBUF    SHIFT MASK
E428 8D 47                      BSR     TDIG      LSB OR ONES DIGIT OF PAIR
E42A 78 A0 14                   ASL     MSKBUF    SHIFT MASK
E42D 7A A0 17                   DEC     PRCNT
E430 27 06                      BEQ     DATON
E432 86 2F                      LDAA    #$2F      OUTPUT A SLASH (/) ONLY ONCE
E434 8D 66                      BSR     OUTCHR
E436 20 EB                      BRA     NXTDAT
E438 86 20              DATON   LDAA    #$20      DATE IS NOW PRINTED
E43A 8D 60                      BSR     OUTCHR
E43C 86 20                      LDAA    #$20
E43E 8D 5C                      BSR     OUTCHR
E440 86 03                      LDAA    #$3       THREE DIGIT PAIRS IN TIME
E442 B7 A0 17                   STAA    PRCNT
E445 86 01                      LDAA    #$01      MAKE UP MASK FOR DIGITS
E447 B7 A0 14                   STAA    MSKBUF
E44A 86 3C                      LDAA    #$3C      SET CB2=1 FOR TIME
E44C B7 80 17                   STAA    PIAC+3
E44F 8D 44                      BSR     DELAY
E451 8D 1E              NXTIM   BSR     TDIG      MSB OR TENS DIGIT OF PAIR
E453 78 A0 14                   ASL     MSKBUF
E456 8D 19                      BSR     TDIG      LSB OR ONES DIGIT OF PAIR
E458 78 A0 14                   ASL     MSKBUF    SHIFT MASK
E45B 7A A0 17                   DEC     PRCNT
E45E 27 06                      BEQ     OUT
E460 86 3A                      LDAA    #$3A      OUTPUT A COLON (:)
E462 8D 38                      BSR     OUTCHR
E464 20 EB                      BRA     NXTIM     GO FOR NEXT DIGIT PAIR
E466 7E E6 00           OUT     JMP     $E600     DONE, NOW EXIT
                        *
E469 B6 80 16           LOOK    LDAA    PIAC+2    B SIDE
E46C B1 A0 14                   CMPA    MSKBUF
E46F 27 03                      BEQ     GOTA      WAIT FOR FIRST DIGIT
E471 5F                 TDIG    CLR     B
E472 20 F5                      BRA     LOOK
E474 5C                 GOTA    INCB              FIND IT 5 TIMES IN A ROW
E475 C1 05                      CMPB    #5
E477 27 02                      BEQ     GOT
E479 20 EE                      BRA     LOOK
E47B F6 80 14           GOT     LDAB    PIAC      READ PA0-5
E47E C4 3F                      ANDB    #$3F      START CONVERSION OF SEGMENT
E480 CE E4 B0                   LDX     #SEGTAB   CODE BY MASKING UNUSED BITS.
E483 E1 00              CONV    CMPB    0,X       NOW COMPARE EACH STARTING
E485 27 03                      BEQ     GOTYA     AT BEGINNING UNTIL MATCH IS
E487 08                         INX               FOUND.
E488 20 F9                      BRA     CONV      KEEP LOOKING
E48A FF A0 19           GOTYA   STX     NUBUF
E48D B6 A0 1A                   LDAA    NUBUF+1   GET LSB OF X AS ASCII
E490 80 80                      SUBA    #SEGTAB-$30
E492 8D 08                      BSR     OUTCHR    CODE OF DIGIT. OUTPUT IT...
E494 39                         RTS
                        *
E495 CE 02 FF           DELAY   LDX     #$02FF
E498 09                         DEX
E499 26 FD                      BNE     *-1
E49B 39                         RTS
                        *
E49C FE A0 15           OUTCHR  LDX     TYPBUF    STUFF INTO STRING AND
E49F A7 00                      STAA    0,X       THEN OUTPUT IT.
E4A1 08                         INX
E4A2 FF A0 15                   STX     TYPBUF
E4A5 BD E1 D1                   JSR     OUTEEE
E4A8 39                         RTS
                        *
                        ********************************************************
                        *
                        *        TABLE OF SEGMENT CODES
                        *
                        ********************************************************
                        *
```

Listing 1. DATIME program.

because I put the table in the same page of memory. I put the table starting at an even address to make the computation easier to figure out when I did it. The technique works and is a convenient way of operating with lookup tables. If you relocate DATIME, change $E491 to reflect the new offset.

The digit that has been computed is first stored in the string TYPMEM (remember $00D7) and output through OUTEEE.

So far, we have found and stored the first digit of the date and have nine more to go. From location $E425, the mask is shifted left and the next digit is found and converted using TDIG as just described. The mask is again shifted now that we have the number of the month.

With one completed digit pair, we output a slash and go for another pair, the day of the month. The digit pairs are counted by PRCNT, a register that had been preset in this case to 2. After the month digit pair, PRCNT is decremented. In this case, we are not yet done with the date. PRCNT is not zero, so we output a slash and get the next digit pair as the day of the month.

With the completion of the date, we have arrived at DATON. Two spaces are printed for cosmetic purposes. PRCNT is loaded with a 3, as there will be three digit pairs: hours, minutes and seconds. After setting up the mask again and forcing CB2 to a one, we delay, then use TDIG again to get the three digit pairs. This time, though, we put a colon(:) between them. When PRCNT reaches zero, we are finally done and branch to OUT.

Here I have set up an exit vector to another of my utilities in EPROM, but you should set this to wherever you want to go next, even if it's to MIKBUG control at $E0E3.

You must change four bytes in the TSC Assembler to leave room for the date and time:

ADDR	OLD	NEW
$0360	8C 00 E6	86 00 D7
$0367	A7 00	A7 0F
$110B	8C 00 E6	8C 00 D6
$1116	8C 00 E6	8C 00 D6

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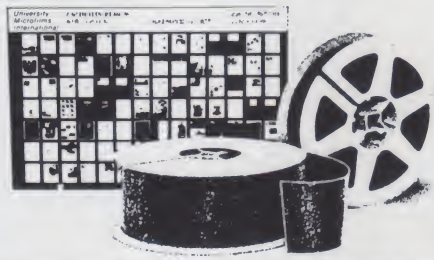
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⌐Reader Service—see page 257

```
E4B0                    *       ORG     $E4B0
                        *
E4B0 3E                 SEGTAB  FCB     $3E,$10,$3D,$39,$13,$2B,$2F,$30
E4B1 10 3D
E4B3 39 13
E4B5 2B 2F
E4B7 30
E4B8 3F                         FCB     $3F,$3B
E4B9 3B
                        *
                                END

   SYMBOL TABLE:
CONV    E483    DATIME  E400    DATON   E438    DELAY   E495
GOT     E47B    GOTA    E474    GOTYA   E48A    LOOK    E469
MSKBUF  A014    NUBUF   A019    NXTDAT  E423    NXTIM   E451
OUT     E466    OUTCHR  E49C    OUTEEE  E1D1    PIAC    8014
PRCNT   A017    SEGTAB  E4B0    TDIG    E471    TYPBUF  A015
TYPMEM  00D7
```

To summarize the four changes, change location $0362 to $D7, $0368 to $0F, $110D to $D6 and $1118 to $D6.

To use DATIME, begin execution at $E400. The date and time will be printed out and stored in RAM locations beginning at $00D7. That's all there is to using it.

As should be obvious by now, the program is written for use in a system with a MIKBUG-type monitor and scratch RAM in the $A000 area. ■

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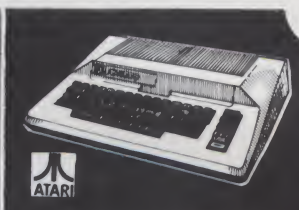
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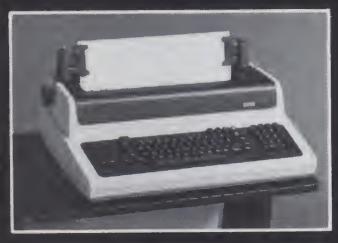


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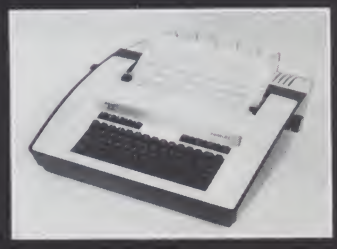
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Three Steps to Better Board Construction

Home-built board-assembly devices can be as good or better than commercial devices.

Assembling S-100 bus cards is a chore not many people enjoy. There are many devices on the market to make this task easier, but most of them cost more than we're willing to invest. This article describes several home-built devices that will perform as well as, or better than, their commercial counterparts . . . and they cost a lot less. If you're about to start construction on a build-it-yourself card, a couple of hours spent building these aids will save some aggravation.

An Assembly Jig

The aid you should build first is an assembly jig. This will allow you to insert components without laying the card on a flat surface, which, as we all know, pushes the components back out. It also allows easy inspection and cleaning of the assembled cards.

The assembly jig is made from three pieces of wood, a small amount of wood glue and four wood screws. Make a 3/8-inch deep notch along the upper edge of the wide side of a 12 x 1 x 2-inch piece of wood. Then cut the piece in half to form two 6-inch pieces.

The drawing in Fig. 1 shows these two pieces attached to a piece of plywood or Masonite (almost any thickness will do) approximately 6 x 11 inches. The distance between the two end pieces is the only critical measurement in the project; the best way to insure that it is correct is to insert an S-100 bus card into the notches, place the card and the pieces of wood on the base, and mark the location of the end pieces.

Photo 1 illustrates what mine looks like, but there are many variations, so do your own thing! Apply wood glue to the bottom of the end pieces and secure with wood screws.

The "Foam Rubber" Trick

Once you have placed the components on the board, you must turn the board over and solder the components without their falling out. The second aid is designed to make this task easier. It is simply a piece of 1-inch foam rubber attached to a 5 x 10-inch piece of plywood or Masonite.

After inserting components, place the foam board over the S-100 board and, holding them together, remove both from the assembly jig. Bind them together with rubber bands as shown in Photo 2. The board can now be turned over and soldering started.

You may find it easier to do this process in stages—inserting the lower-profile components first, soldering them and then inserting the higher-profile components and soldering them. This will insure that all components will be held snugly against the board.

A Flexible Arm

The third aid is a flexible arm that enables you to position your card in almost any position. It is especially helpful in removing components when you need to hold the soldering iron on one side and remove the component from the other. The flexible arm consists of a card holder made from two Altair card guides and a piece of ¼-inch square aluminum stock about 12 inches long (see Photos 2 and 3).

Position the card guides on the square stock using the same method for positioning the end pieces of the assembly jig. One end of the stock is rounded with a file to fit into a flexible lamp neck.

There are many methods of

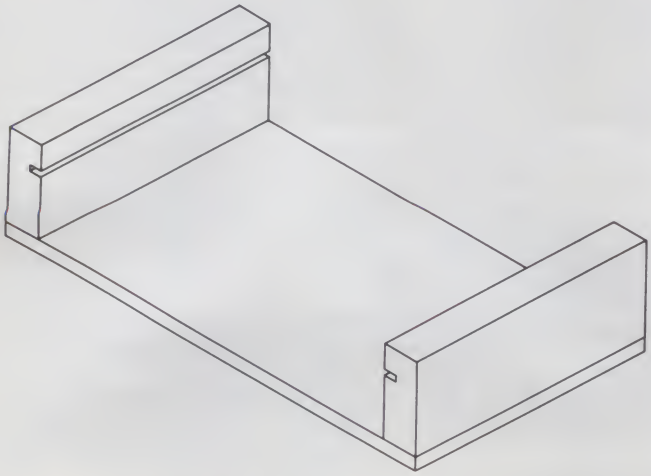


Fig. 1. Assembly jig.

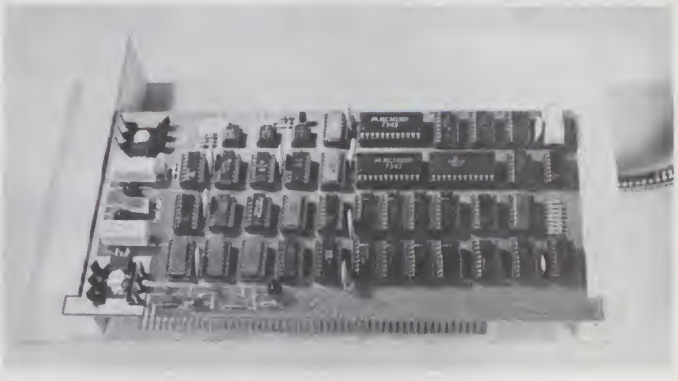


Photo 1. The assembly jig with board in place for inspection.



Photo 2. Foam board with rubber bands in position for component soldering.



Photo 3. The flexible-arm card holder. Note the compression type potentiometer lock.

securing the card holder to the flexible lamp neck; the method shown here uses a compression-type potentiometer lock, but almost anything that can provide a friction lock will work. It is best to use a method that can be loosened and tightened easily so that full advantage can be taken of the arm. The other end of the flexible lamp neck should be secured to some kind of base; I used the assembly jig itself, but anything that will provide a firm nonmovable base will do.

Summary

Some other things you will need for card assembly include a good, low-wattage soldering iron, a good grade of solder (I use Kester "44," SN60/40, .031-inch resin core solder), lacquer thinner for cleaning off all the residue from soldering and an IC-insertion tool. Don't underestimate the importance of this last item: If you have ever spent hours of troubleshooting, only to find a bent-over IC pin from manual insertion, you know what I am talking about. The OK Model INS-1416 is a good low-cost inserter and pin straightener.

These aids have significantly shortened the time it takes me to build an S-100 card, and I think they help to produce a better job because they lessen the fatigue inherent in soldering hundreds of connections. I am sure that these designs can be adapted to almost any-type card; so for those of you who don't have S-100 bus computers, have at it! ■

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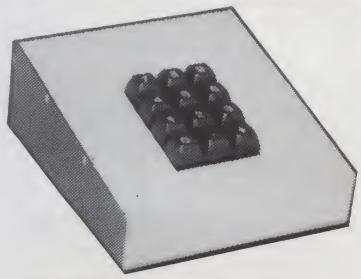
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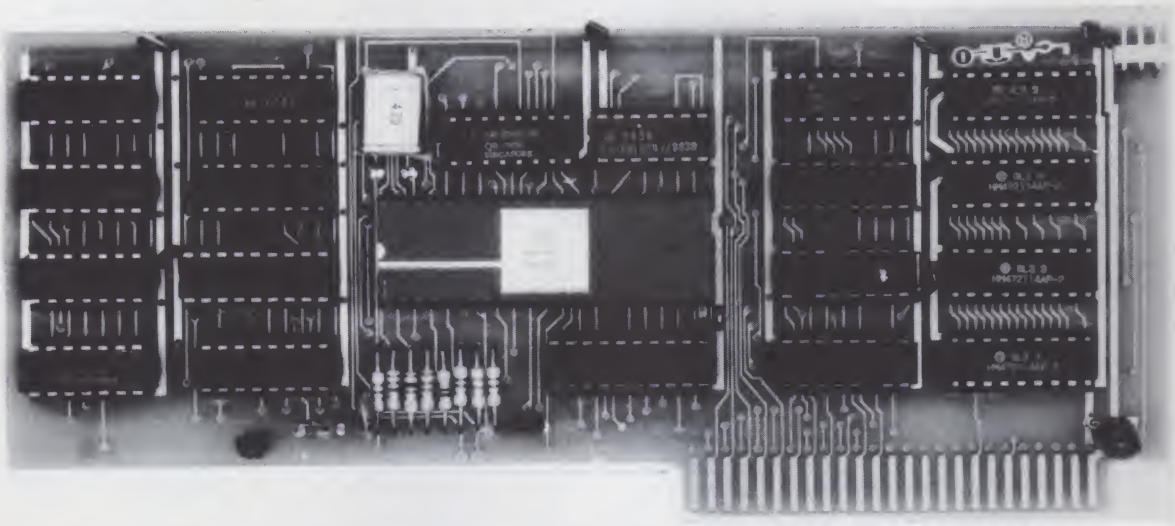
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Graphs, Plus

The "handle on programming" series continues with this graphic installment.

The title of this article is "Graphs, Plus." The plus means that the routines contained in the programs may become useful in your own personal cookbook. I am using the term "graph" to indicate a plotted curve that has a relationship to the data points used to develop the curve. Program listing 1 shows the graph of a sine wave. The listings are not too onerous to key into your TRS-80, and only by so doing will you get the chance to implement, change and otherwise embellish and innovate . . . and, incidentally, learn.

```
3  CLS
5  REM GRAPH OF SINE WAVE WITH OR WITHOUT BACKGROUND
7  CLEAR 150
10 FOR X= Ø TO 767 STEP 48
20 PRINT [a] X, STRING$(112,CHR$(149))
30 NEXT X
40 REM LINES TO THIS POINT SET BACKGROUND
45 REM CLS AND RUN 50 GIVES SINE CURVE WITHOUT BACKGROUND
50 FOR X = Ø TO 120 STEP 2
55 J= SIN((X*6) * .01745) * 15
60 Y=19: REM VERTICAL CENTERING FACTOR
70 IF POINT (X,Y ) RESET (X,Y-J)
75 IF NOT POINT (X,Y) SET (X,Y-J)
80 NEXT X
90 END
```

Listing 1. In line 20, [a] is the @ symbol.

How the Program Works

The opening lines clear the screen (CLS) and set aside string space for setting the background, which appears first. This portion terminates with line 30. Lines 50, 55 and 60 input the data values of the sine wave to be graphed. In line 55, the *15 at the end of the line sets the amplitude of the sine wave. Line 60 is the factor that centers the sine wave on the screen.

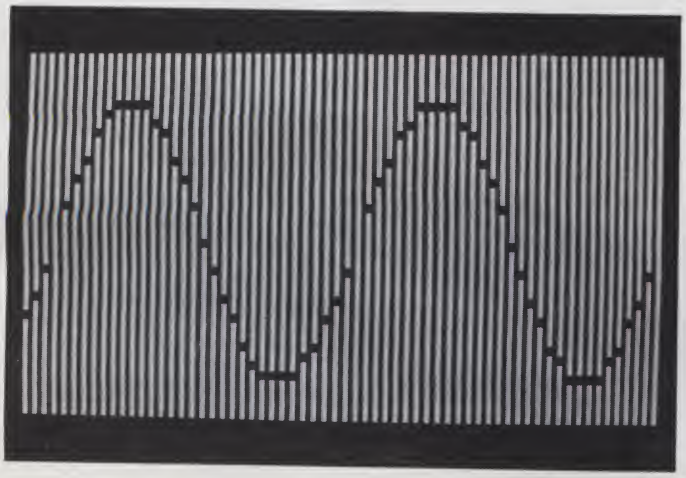
In line 55, the expression SIN(X*6) sets the number of complete sine waves that will appear. If you changed this to SIN(X*3), then one wave would be graphed. If it were to appear as SIN(X*12), then four waves would be graphed. As pointed out in the remark statement in line 45, a CLS and RUN 50 will dispense with the background and print out the graph as a series of properly placed spots of light.

If line 50 were altered to eliminate the STEP 2 statement, then the graph would assume a sort of "white on white" character, which I find interesting. This is a function of the POINT and NOT POINT statements in lines 70 and 75. If you would like to see a "whiter on white" effect at this point, just delete line 70.

Still sticking to the sine wave, let us advance to a different type of graphing plot. In this instance it may be called a "modulation envelope" type of graph. Listing 2 gives the TRS-80 its instructions.

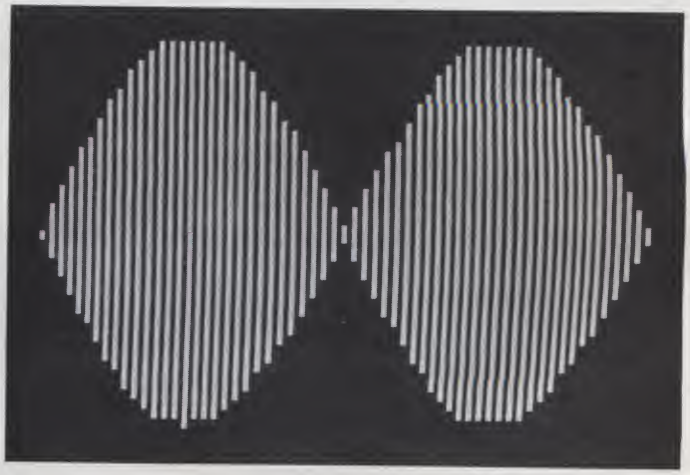
The program lines to line 40 calculate the data points that will form the curve. Line 30 sets the number of waveforms to be plotted and controls the amplitude of the image. Lines 50 and 60 center the image on your monitor screen. The balance of the program sets the points of light that produce the image.

If you follow the suggestion in the remark statement in line 90, you will see the equivalent of



Sine wave plot with background.

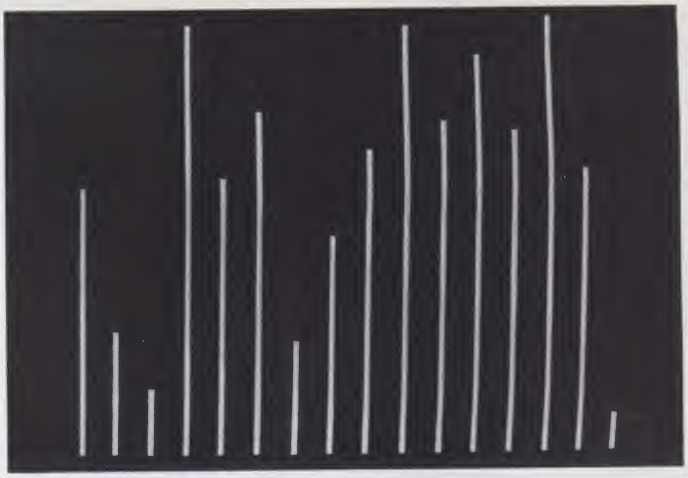
(Photos by Ira Joffe)



Modulation envelope type of display.

```
5  REM MODULATION ENVELOPE BAR GRAPH DISPLAY
10 CLS
20 FOR X= Ø TO 120 STEP 2
30 J= SIN((X*3) * .01745) * 20
40 IF J< Ø  THEN J = ABS(J)
45 REM NEXT TWO LINES CONTROL VERTICAL CENTERING
50 Y= 23+J
60 W= 23-J
70 FOR V = W TO 23
80 SET (X,V)
90 NEXT V: REM TRY ADDING LINE  95 GOTO 140--IT'S RECTIFYING
110 FOR V2 = 23 TO Y
120 SET (X,V2)
130 NEXT V2
140 NEXT X
150 GOTO 150
```

Listing 2.



Vertical bar graph. Normal video display.

```
7  REM VERTICAL BAR GRAPH
10 DIM P(20)
15 CLS
20 FOR R = 1 TO 16
30 P(R) = RND(45)
40 NEXT R
50 FOR X = 1 TO 16
60 L= 45-P(X)
70 SET(7*X,(45-P(X)))
80 FOR T =45 TO L STEP -1: SET (7*X,T): NEXT T
90 NEXT X
100 GOTO 100
```

Listing 3.

half-wave rectification. If you then delete this insertion, you can change line 50 to read: 50 Y = 23 + (– J). When you are in the mood to think a bit, try to analyze why the new line 50 does what it does.

Bar Graphs

Program listing 3 will give your computer the data and directions to implement a vertical bar graph. Lines 20 to 40 input random data so that you do not have to type in 16 numbers to see the program run. If you want to input your own figures at a later date, then change line 30 to: 30 INPUT P(R).

Notice that, since we are dealing with the graph on an elemental level (which precludes too much on scaling factors), if any P(R) value exceeds 47, then we will bump into the top of the screen and will generate an error message. This makes the random input statement convenient for seeing just how the program runs, for the intent here is generating the graph more so than anything else.

If you watch the program run, you will see that a point is set at the maximum value of each data element and then the graph line is finished. This point is set by the routine in line 70. The remainder of the program is fairly easy to grasp.

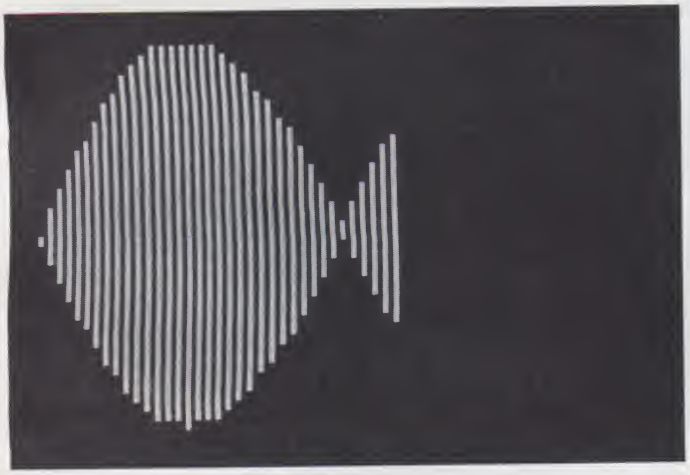
Now if we add the program modification in Example 1 to Listing 3, we can produce the same graph in a reverse video presentation. In lines 70 and 80 change SET to RESET. This completes the changes for the reverse video presentation of the graph.

Before going on to the horizontal bar graph, consider that the fundamental vertical bar graph has a long horizontal base line of some 128 positions, so that if we used every fourth one, we could plot 32 independent pieces of data with some viewing comfort. It has a potential maximum (without scaling) of 48 in the vertical dimension.

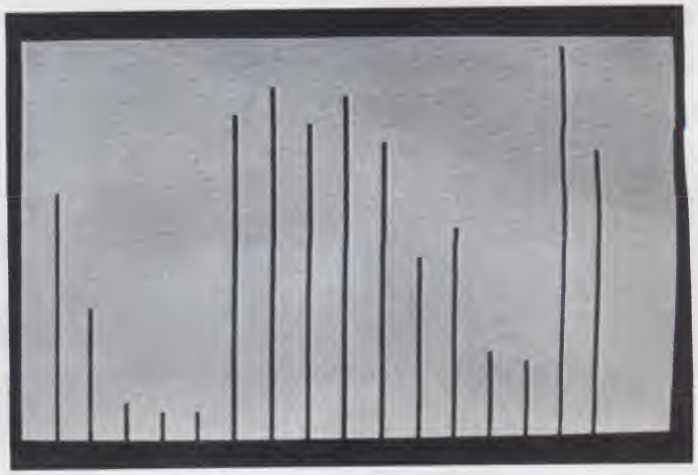
If we now turn the vertical graph on its side, these two fac-

```
   5  CLEAR 500
  47  GOSUB 2000
2000  C$=STRING (192,CHR$(191)):PRINT C$;C$;C$;C$;
2010  PRINT STRING$(128,CHR$(191));
2020  RETURN
```

Example 1.



Fancy fish using modulation envelope display.



Vertical bar graph. Reverse video display.



Annotated horizontal bar graph.

tors will be reversed. It may seem that we haven't gained anything, but if you can be induced to share my perspective, we may just have done exactly that.

The biggest gain is that our data values can now go as high as 128, and if we hold them to a maximum value of 100, this will simplify scaling, if and when needed. If you are graphing data to be expressed in %, then this type of graph is a natural

Program listing 4 sets forth one way to program the horizontal bar graph. Notice that the RND function in line 30 is RND(127), so that when you run the demonstration program you stand the chance of using the entire 128 horizontal positions available in the TRS-80 graphics. The program is concise and to the point. The expression in line 80 (T,3*X – 2) controls the vertical separation of the adjacent horizontal graph bars.

```
1  REM HORIZONTAL BAR GRAPH
5 CLS
10 DIM P(20)
20 FOR R= 1 TO 16
30 P(R) = RND(127)
40 NEXT R
50 FOR X = 1 TO 16
60 L= P(X)
80 FOR T = Ø TO L STEP 2: SET(T,3*X-2): NEXT T
90 NEXT X
100 GOTO 100
```

Listing 4.

```
1 REM ANNOTATED HORIZONTAL BAR GRAPH
5  CLS
7  CLEAR 200
10 DIM P(100)
20 FOR R = 1 TO 16
30 P(R)=RND(100)
40 NEXT R
45 Q=Ø
50 FOR X = 1 TO 16
55 PRINT [a] Q, P(X);
60 PRINT [a] Q+5, STRING$((P(X)/2),CHR$(61));
80 Q=Q+64
90 NEXT X
100 GOTO 100
```

Listing 5.

Program listing 5 continues the evolution of the horizontal bar graph with the following items added to the fundamental program in listing 4. First of all, listing 5 offers a graph that will print out on the screen in a much shorter time than listing 4. Next, each bar of the graph will be supplied with annotation; a printed value is shown at each bar position to indicate the value of the bar. Finally, it includes the offer of selecting the print form of the bar itself. This is very much a question of taste in the eye of the beholder, so once the method is made clear, you can please yourself.

In order to make room for the printing of values, the maximum data value for any one bar ranges from 0 to 100. So for the demonstration program, line 30 shows a RND value of RND (100). Lines 45, 55 and 60 are concerned with printing data values along with line 80. In line 60 if CHR$(61) is used, the bars are formed of equal signs(=). CHR$(45) in line 60 produces a dash (–) graph; CHR$(46) produces a period(.) graph; and CHR$(58) produces colons(:). My personal preference is either the equals sign or the colon. The faster print of the graph is due to the construction of line 60, which uses the PRINT command rather than the SET command. I hope this little excursion into the land of graphs will open some new vistas to using your TRS-80. ■

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Anyone who's programmed an 8080-based micro in other than BASIC will probably agree with me that a serious shortcoming is the lack of relative addressing. Even the rival 6800 has one type of indexed addressing. Many of us have a lot of time and money invested in 8080 systems and aren't about to start over again, at least not until something substantially better comes along—my next machine will undoubtedly be a 16-bit processor.

Schemes have been proposed in *Microcomputing* and elsewhere for 8080 code relocation. Implicit in most of them is the need for a special loader that can recognize certain symbols embedded in the code to define program and data areas and make the necessary address changes as it loads.

The method proposed here requires no such loader and, in addition, requires no changes to system software. It does require one extra byte for every 3-byte instruction referencing a relative address and also requires 24 bytes of available memory starting at the RST 1 location. Other RST locations may be used depending on whether they are required by your system software or are free for use.

CP/M, for example, uses the RST 0 location and reserves RST 6 and RST 7, but otherwise makes no demands on RST 1-5. The North Star DOS, in its standard form, resides at 2000H and runs most other software at 2A00H and up. You need some memory at 0 for this method, which otherwise doesn't need to be there for North Star systems.

Principles

In the more advanced micros and minis, relative program addressing is usually based on the location of the program counter. Jumps, calls and other references to memory locations are set up as relative offsets to the program counter's present position. Other types of addressing such as index addressing, where a location is defined as an offset from a particular register (not necessarily the program counter), are also used and accomplish much the same result.

In the 8080, however, it's tricky enough just to find out what the value of the program counter is, let alone make use of it in an addressing scheme. Two basic requirements exist: there must be a way of determining at any point in the program what the value of the program counter is; the proper offset must be added to it to obtain an absolute address that can be used in any 8080 3-byte instruction.

The first of these is satisfied by setting up the RST 1 location to get the program counter from the stack, where it is automatically pushed when the RST instruction is executed, and placing it in the H,L registers. The second is accomplished by using this value to fetch a relative address that is initially stored as the argument to the 3-byte instruction and add it to the PC to produce the absolute address required. Finally, this absolute address is stored in place of the relative address, and the RST instruction is replaced by a NOP so that the modification routine only has to run once for each relative jump or call. Thus the only decrease in execution speed is due to the miscellaneous NOPs left in memory by the modifier program.

The NOP is a fast instruction, and unless it is located in a loop where there are very few other instructions, it will probably not be noticed.

A side benefit of this method is that the modifier leaves behind it a trail of NOPs replacing RSTs, thereby allowing you to determine whether a particular part of the program has been executed yet. This doesn't take the place of a fancy debugger, but it can come in handy by flagging the areas of the program that the PC has "seen."

Programs

Two programs are required to make this sytem work. The first is the code-modifier that resides at RST 1 and takes up 24 bytes of memory. The second is a short program that you must execute before any other program when you turn the system on. You can do this by placing the program at the beginning of the initializing routine called by most systems first thing after power-up. Another way is to insert it as part of the code of a main program preceding any instructions with relative-address operands. The first program is implicitly contained within the

```
;
;       Program for initializing modifier
;
INIT:   LXI     H,0E9E1H        ;Put POP H, PCHL at RST 1
        SHLD    0008H
        RST     1               ;Get PC in H,L
        LXI     D,PUT-$         ;Add offset to get PUT
        DAD     D
        MOV     B,H             ;Move PUT to B,C
        MOV     C,L
        RST     1               ;Get PC in H,L
        LXI     D,RELRT-$       ;Add offset to get RELRT
        DAD     D
        LXI     D,0008H         ;Set D,E to RST 1
        MVI     A,18H           ;Set A to byte count
PUT:    PUSH    B               ;Transfer to RST 1
        PUSH    PSW
        MOV     A,M
        STAX    D
        INX     H
        INX     D
        POP     PSW
        DCR     A
        RNZ
        POP     B               ;Clean up stack
        PCHL                    ;Continue with program
                                ;(Can be changed to RET if
                                ;initialization complete)
;
RELRT:  DB      0E3H,2BH,36H,00H,23H,23H,0D5H,5EH
        DB      23H,56H,0F5H,0EBH,19H,0EBH,1BH,1BH
        DB      72H,2BH,73H,0F1H,0D1H,2BH,0E3H,0C9H
;
;       (Remainder of program)
;
```

Program for initializing monitor.

second as data, so there is actually only one program to assemble.

Inspection of the modifier program shows that it is relatively simple. All it does is retrieve the PC and change it accordingly to alter the operand address of the instruction. In doing so, it preserves all flags and registers so that there is no need to do this inline. It also puts the NOP in place of the RST to assure that the process will not occur again in all succeeding passes through that part of the program. This reduces execution time.

The initializing program simply places the modifier program into RST 1 (or other RST location) and then continues with the rest of the program. Note that this program can locate anywhere in memory and still run properly.

To make this whole procedure work, you insert an RST 1 instruction before any relative 3-byte instruction. In addition, when you write the program (presumably with an assembler), you must express all operands of the 3-byte instructions (label-$) so that they express the location of the label relative to the beginning of the instruction. (Caution: Some assemblers assign the value of the beginning of the *next* instruction to the $ symbol, so be careful! If yours does this you'll have to change the modifier slightly to account for it, but the change is easy.) The CP/M assembler is "well-behaved" and should function normally with the 8080.

Note that this method does not destroy the ability to use absolute addressing. All you have to do is leave out the RST 1, and the 3-byte instruction is treated as absolute. This makes it possible to mix relative and absolute code together. More effort is required to include the RST 1 where needed, and make sure the location counter is subtracted from the labels. A little practice with this can go a long way.

Since normal system software can be left entirely alone, you can experiment with your assembler and find the area that gets the value for $. Then patch it slightly to recognize any symbols or labels starting with a special character as relative, and automatically subtract the location counter from them.

An Application

Consider the input routine for a console device with a wait loop. I/O routines are routines you may want to run in different parts of memory and not want to reassemble each time. A normal routine might look like:

```
INPUT:  IN      STAT
        ANI     FLAG
        JZ      INPUT
        IN      DATA
        ANI     MASK
        RET
```

The reference to INPUT must be absolute if the routine is to execute properly. Write this in position-independent code, and it becomes:

```
INPUT:  IN      STAT
        ANI     FLAG
        RST     1
        JZ      INPUT-$
        IN      DATA
        ANI     MASK
        RET
```

The only changes required are the RST 1 immediately preceding the JZ instruction and the change of INPUT to INPUT-$. After the loop is executed once and the modifier program is run, the operand of the JZ will change to the actual value of INPUT and the RST 1 will be a NOP. This prevents the modifier program from having to run each time the loop is run and also says that the loop has been executed at least once (from the presence of the NOP).

I tried this procedure with the CP/M I/O routines, and it worked without a hitch. Preceding user programs with these changes allows them to be executed anywhere in memory or to be appended as object code rather than source code, neglecting complications that occur with cross-references between programs.

This short program doesn't turn the 8080 into, say, a PDP-11, but I think it's an improvement over what Intel gave us to start with. ■

```
;
;       Program for modifying addresses.
;
RST1:   XTHL                    ;Save H,L and get next PC.
        DCX     H               ;Change RST 1 to NOP.
        MVI     M,00H
        INX     H
        INX     H
        PUSH    D               ;Save D,E.
        MOV     E,M             ;Get relative addr. in D,E.
        INX     H
        MOV     D,M
        PUSH    PSW             ;Save condition codes.
        XCHG                    ;Add offset for abs. addr.
        DAD     D
        XCHG
        DCX     D               ;Set to beginning of instr.
        DCX     D
        MOV     M,D             ;Store absolute addr.
        DCX     H
        MOV     M,E
        POP     PSW             ;Restore condition codes.
        POP     D               ;Restore D,E.
        DCX     H               ;Set H,L to start of instr.
        XTHL                    ;Restore H,L.
        RET                     ;Execute.
```

Program for modifying addresses.

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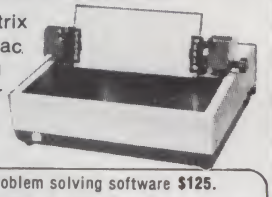
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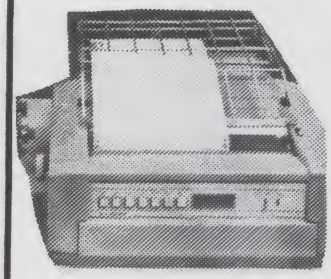
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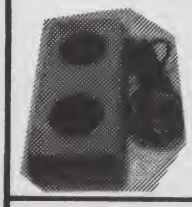
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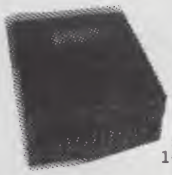
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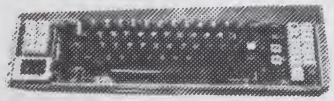
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The 6802 Revisited

Inspired by an article back in September 1978, this author carried it further.

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Tim Ahrens' article about the 6802 ("Motorola's Latest: The MC6802," p. 92) appeared in the September 1978 *Kilobaud*. Hardware nuts should like the 6802. With a dozen chips, a Teletype and a cassette recorder, you've got a system!

The point of this article is twofold. First, for the benefit of those who would like to build a 6802, I point out some errors in the Ahrens article. To follow this part of the story, you should have a copy of Ahrens' article.

Second, the more interesting point isn't really about the 6802. Remember 1972, when the first micro came out, and your false teeth fell out to keep it company? Well, the industry is older now, so you might not be too excited to hear that the 6802 is just another 6800, but with the clock oscillator and 128 bytes of RAM thrown in.

The part of the system that makes it hot stuff is the MC6846P1. Hiding between the I/O ports and the timer is a 2K ROM loaded with Motorola's MIKBUG 2.0, an executive that handles some powerful I/O between the Teletype, the 6802 and the recorder. With this small system you'll be able to load programs, run, edit and store it all on tape.

Ahrens described the system, but left little room to show how it would work. In this article some hardware suggestions are offered and the corrections are noted. I then outline the operating features of MIKBUG, which, at the time I wrote this article, were hard to find. By the time you read this, Motorola should have more documentation available (ask Motorola for AN-788, August 1978, a summary of the system).

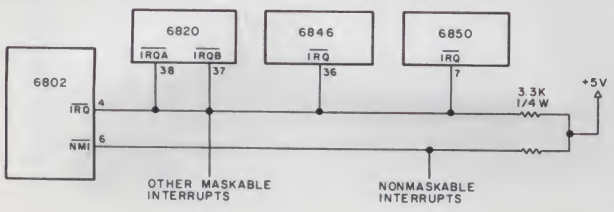


Fig. 1. Interrupt wiring.

6802 Hardware

Pins 2, 3, 4, 6 are shown tied to +5 V in Fig. 2 of Ahrens' article. A designer wishing to take full advantage of the system is better advised to tie these separately to +5 V through 3.3k resistors.

Suggested wiring of the $\overline{IRQ}$ and $\overline{NMI}$ interrupts is shown in Fig. 1 (see also Fig. 1 of Ahrens' article). Then any of the unused functions on the 6846 IOT (input-output-timer), the 6821 PIA (parallel interface) or others can pull one of these lines low to cause an interrupt.

The debounce circuit shown for the RESET pin is not needed because of an internal Schmitt-trigger in the 6802. But it wouldn't hurt for any switch input. The 74LS279 quad S-R latch is suggested for this. If the pins can be filled it is cheaper to use than 7400s.

By the way, I prefer 74LS over 74 series TTL for most logic because it is usually more compatible with MOS LSI chips, uses much less power and costs little more. But check compatibility before substituting. Always secure complete information before using a part.

6846P1 Hardware

The buyer normally specifies the chip-select pattern and contents for the ROM on this part. The P1 suffix describes the part loaded with MIKBUG. It is masked so that $\overline{CS0}$.CS1 (the period means logical AND) selects the I/O and timer (IOT) functions, and CS0.CS1 elects ROM. The IOT addresses generated by MIKBUG are $A100-7 (hexadecimal). ROM addresses are $F800-FFFF.

The system in Fig. 2 of the September article shows VMA.A15 as CS0 and A14 as CS1. Reverse these connections to use the IOT functions. Then the top 32K of the address space will select the 6846. This is an example of partial decoding. It works fine and is inexpensive but it freezes a large block for just one chip.

In this form $8000-BFFF se-

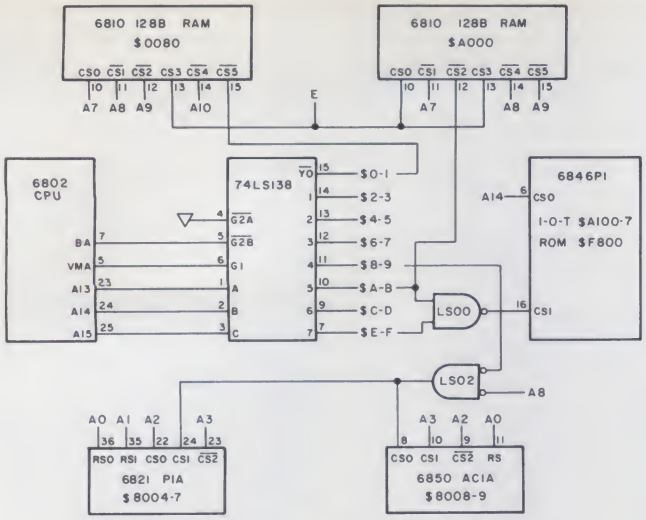


Fig. 2. MC6802-MC6846P1 address decoding.

lects the IOT, and $C000-FFFF selects the ROM. But there is more to it. The IOT also requires that A3 to A6 be low and A8 be high. Thus the IOT responds to $A100 but not $A000, which is used by MIKBUG for RAM functions such as the MPU stack. Nor does $8004, the PIA address, trigger the IOT.

Addressing can be tightened by using a 74LS138 octal decoder to expand the three MSBs of the address (see Fig. 2). The IOT address range is reduced to $A000-BFFF (8K), and several other decoding signals are made available. I used $\overline{Y1}$ to gate a second '138 to generate eight chip selects for 8K of 2214 RAM.

Fig. 2 shows a second 6810 RAM. Since the 6800 instruction set provides 2-byte addressing for the lowest 256 bytes of address, it seems prudent to wire the entire block even in a basic system. The 6802 contains the first 128 bytes.

6850 Hardware

A cost-cutting change can be made in the timing of the ACIA. The MC14411 and its crystal shown in Fig. 1 of the Ahrens article cost about $25. Instead, a 2.4576 MHz crystal can be chosen for the 6802. The E signal will be 0.6144 MHz. Dividing this by 128 in two 74LS93 binary counters (Fig. 3) yields the control pulse for 300 baud receiving and transmitting. The 110 baud signal, if needed, can be generated in a third '93 by dividing the 1200 baud signal by 11, using logic to reset the '93.

The slower clock relaxes memory timing requirements, so less costly chips can be used, and should generally make the system more reliable. However, if speed is wanted, the 4.9152 MHz crystal frequency is also a standard, and the same circuit can be used by redefining the '93 outputs. Ahrens said that his system worked at 5 MHz.

There are some errors in Ahrens' Fig. 1; these are corrected in my Fig. 4. Some refinements for the EIA RS-232 interface are added. The IDs of the transmitter and receiver chips are interchanged. Pin 1 of the 1488 should be −12 V.

Adding bias to the response controls (pin 2, etc.) of the 1489 moves the logic switch point from 0 V to +3 V to conform closer to the EIA specs. (Consider RS-449 for new work. EIA says RS-232 is obsolete. RS-449 is compatible with old RS-232 hardware.) The capacitors on the 1488 outputs slow the level shifts to the rate allowed in the EIA specs, 30 V/us.

The Motorola data sheets for these parts include useful information on the RS-232 interface. See also October 1978 *Kilobaud*, page 46.

Terminal Commands

What will the system do? The list of commands given here is intended as a hint at its capabilities. Check with Motorola for a more complete manual.

RESET causes default to MIKBUG control. This is the first action, and can be used when things get out of hand. MIKBUG sends a line feed, carriage return and asterisk (*) to the printer. Commands are valid only after the asterisk.

The memory examine command M sounds like the most useful. The location is typed in four-character hex after a space is printed. Contents at one location are printed in hex. You can change the memory contents if desired. Control can pass to the previous location (↑ or shift N), the next one (line feed) or back to MIKBUG (carriage return).

The S1 and S3 commands choose between one (S1) and two (S3) stop bits for 110 baud or 300 baud data exchange. The rate is actually set by the 6850 clock frequency, the switch in Fig. 3. MIKBUG initializes for S1 every time RESET is actuated.

There are four commands for breakpoints, locations where execution will stop and MIKBUG will take control. Command B prints all breakpoint addresses; D deletes them all. V will set one, and U will remove one. The latter two return a space; then the address to be set or deleted is typed.

Gnnnn will start execution at location nnnn (hex). C loads the stack into the MPU and starts the run with the program counter (see R below). In both cases the program goes on until a WAI or SWI instruction is met, a breakpoint is reached or RESET is actuated. Register contents are printed at SWI or a breakpoint.

There are two trace instructions in which the system prints the contents of all MPU registers after an instruction is carried out. N traces the next instruction, and Tnnnn traces the next nnnn (hex number of) instructions.

R will move the MPU registers to the stack and print them in the following order: C_1 B_2 A_3 $X_{4,5}$ $P_{6,7}$ S—condition code register, B and A accumulators, index register, program counter and stack pointer address. (All other register printouts also use this order.)

Use the M instruction after R to change register contents, using the address S + I. S is the stack pointer address that was printed. I is the subscript given in the above list. Use command C to return the modified contents to the MPU.

Finally, there are two paper tape print/punch commands carried over from MIKBUG 1. These assume an ASR Teletype as the interface. L loads tape, and P punches in MIKBUG format and also prints at the terminal. In the latter case the start/stop addresses must first be loaded at $A002-5 with the M command.

Cassette Interface

TEXORTAPE software allows fast exchange with a cassette through the 6821. Data are sent synchronously without start/

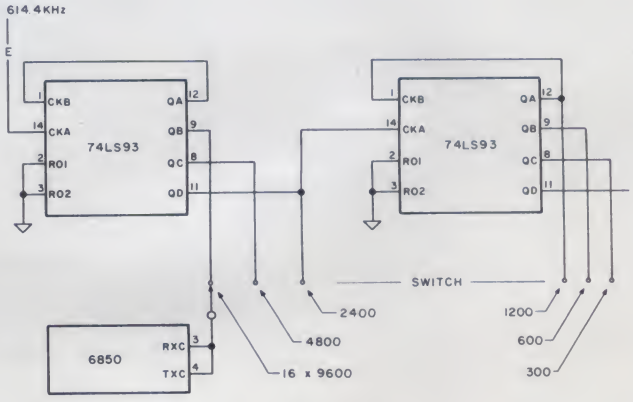


Fig. 3. ACIA clock.

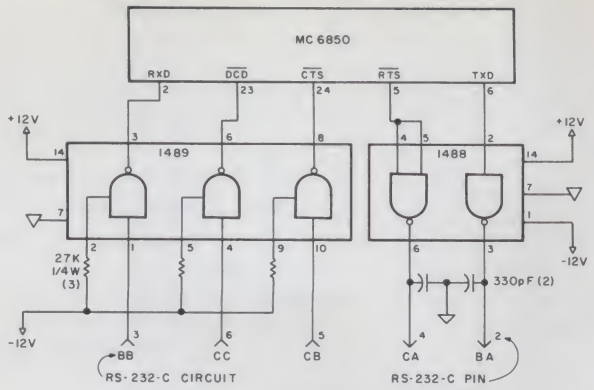


Fig. 4. RS-232C interface.

stop bits, the MSB first. The cassette can also be used for voice messages between files.

There are four commands. First type E to leave MIKBUG. The EXORTAPE 4.3/CLDS: response prints.

Command S prompts with SPEED. Type 04, 08, 12, 16 or 20 to select the data rate. 04 is 400 baud, and so on.

D dumps from memory to tape in 256-byte pages. The response is FILE ID:. The user enters a file number, four decimal or hex digits. Then TEXORTAPE types STARTSTOP PAGES: and the user types four hex digits, the first 2 the most significant byte of the start address and the last 2 the same for the last page of data. D is printed for each page transmitted.

L loads from tape to memory. TEXORTAPE asks for the FILE ID. Then the user turns on the tape unit. An X is printed for each incorrect file encountered, an H when the right file comes up, a G for each data page loaded properly and a B for each bad page load.

The C command checks each record of the file for the proper checksum at the end, but does not load memory. G is printed for each good record, B for each bad one.

D, L and C return control to MIKBUG.

Conclusion

Having trouble finding parts? Jameco has most of the parts mentioned at attractive prices. Newark has the crystals.

There are alternatives to every design. The 6800 can be used in place of the 6802. I hope you know by now that the 6820 PIA mentioned in Ahrens' September 1978 article has been replaced by the 6821. The 6846 RIOT can be replaced by the 6840 timer if some other control ROM is preferred.

How about a TV system? Motorola has TVBUG firmware in its 6846P3 part, with which a standard TV can be used as part of a small system. Tim Ahrens described this system in his June 1979 article ("TVBUG," p. 48). If you have no RS-232C keyboard/display, you will find that a cheaper system to build than the one in this article. All the commands described here, plus color graphics, are included.

Safety factors are nice to have. Motorola hangs everything but bedsheets on their unbuffered buses, and maybe it works. But the 6802 will only tolerate an output-low load of 1.6 mA, one TTL unit load or four LSTTL loads. In my system the address, VMA and R/$\overline{W}$ are buffered by '367s, and the data by an 8304 octal transceiver (AMD or National). E and BA are separately buffered, and BA Tristates the others for DMA applications. If something goes haywire, only the less expensive parts will burn.

I hope all this helps, and have fun wire-wrapping! You are almost sure to run into trouble, but it's fun to work your way back out, and much more educational than a kit. When it finally works, the smile will split your gums. ■

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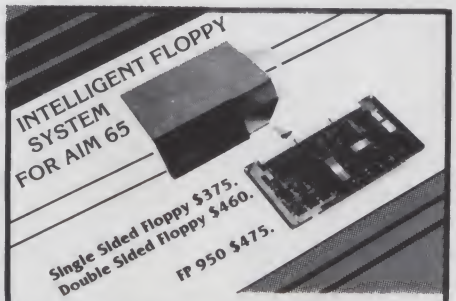
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UFO Defense

Born of previous Apple games, this stellar strategy invites you to go at it.

Dr. Terry M. Mikiten
6602 Pembroke
San Antonio TX 78240

In the past these pages have seen the handiwork of Bob Bishop in his Apple II games, STAR WARS (February 1978, p. 52) and "Rocket Pilot" (January 1978, p. 90). I've run and enjoyed these programs on other machines, but never on my own. The reason is that I don't yet have the 16K required to feed the high-resolution graphics.

So, to give our 8K beauty its own cosmic fantasy, my sons (Shawn, Brian and Erick) and I evolved UFO Defense one weekend. I have a suspicion that the program will run in 4K but haven't tried it yet. It seems likely that some of the fat can be trimmed to make it fit (delete instructions).

The Game

The program generates UFO ships of three different kinds They are selected randomly and are given different colors. Each UFO starts its run at the right edge of the screen display and moves leftward along a horizontal corridor. As the UFO goes, it executes evasive maneuvers within the corridor. As it moves across, the player's job is to use the game paddles (one controls vertical movement and the other, horizontal movement) to direct a guided missile into the UFO. It must be directed into the central nuclear reactor core of the ship (colored red). When a hit is made, an explosion is seen and heard as the ship is annihilated. The player must destroy as many of the 20 UFOs as he can.

The scoring routines in the game take several things into account. First, you receive a high score if you hit a ship close to its point of appearance at the right of the display. It pays to be alert. You also get a higher score if you hit a quickly moving ship than if you hit a slower one. You can see, then, that the highest scores are given to UFO hits on fast ships at the right of the screen.

Because UFO ships and their characteristics are randomly generated, each game is a fresh experience. The drawback is that you may occasionally get (by chance) a preponderance of fast (or slow) ships. To keep such things from generating distorted scores and to permit comparisons between games, a routine notes the highest possible score on each run, as well as your actual score. The final tally shows your performance as a percentage of the maximum possible score you could have obtained (i.e., if you had destroyed each ship as soon as it appeared in the game space).

Note that the game space does not coincide with the right edge of the screen but is shifted leftward to give the player time to react to the UFO's appearance. You can easily locate the right edge of the game space by moving the missile to its extreme rightmost position.

Program listing.

```
 10 REM  FROM MIKITEN CO. AND THE COMPUTERSHOP:SAN ANTONIO
 20 DIM A$(76)
 30 CALL -936
 35 VTAB 11: TAB 9: PRINT "**** UFO DEFENSE ****": VTAB 13: TAB
    11: PRINT "AN APPLE II GAME": FOR I=1 TO 2000: NEXT I
 36 POKE 2,173: POKE 3,48: POKE 4,192: POKE 5,165: POKE 6,0: POKE
    7,32: POKE 8,168: POKE 9,252: POKE 10,165: POKE 11,1: POKE
    12,208
 37 POKE 13,4: POKE 14,198: POKE 15,24: POKE 16,240: POKE 17,5:
     POKE 18,198: POKE 19,1: POKE 20,76: POKE 21,2: POKE 22,0: POKE
    23,96
 38 CALL -936
 40 VTAB 12: TAB 13: PRINT "YOUR NAME PLEASE ": VTAB 14: TAB 13
    : INPUT A$
 50 CALL -936
 60 VTAB 12: TAB 7: PRINT "WELCOME TO U.F.O DEFENSE,": VTAB 14:
     TAB 7: PRINT "GUNNER ";A$
 70 FOR I=1 TO 2500: NEXT I
 80 REM  INSTRUCTIONS
 90 CALL -936: VTAB 12: TAB 4: INPUT "DO YOU NEED INSTRUCTIONS? (Y O
    R N) ",A$: IF A$="N" THEN 160
100 CALL -936
110 PRINT "20 UFOS HAVE BEEN SIGHTED COMING FROM ": PRINT : PRINT
    "THE EAST (SCREEN RIGHT)"
120 PRINT : PRINT " USE YOUR TWO GUIDED MISSILE CONTROL ": PRINT
    : PRINT "PADDLES TO DIRECT THE MISSILE ONTO THE ": PRINT
130 PRINT "RED NUCLEAR REACTOR ZONE OF THE UFO"
140 PRINT : PRINT " THE CLOSER TO THE RIGHT OF THE": PRINT : PRINT
    "SCREEN YOU HIT, THE HIGHER YOUR SCORE": PRINT
```

Line Changes

Although tinkering with programs can invite disaster, there are some things you can do to customize the game. For example, line 210 (FOR L = 1 to 20) determines the number of UFOs. Simply make the 20 any value you prefer. Here are some other things you can do:

- Line 220 (S = RND(2) + 1) sets the rate at which a UFO moves across the screen. As it stands, two speeds are randomly chosen (values for S of 1 or 2). For a wider range of speeds try changing line 220 to S = RND(3) + 1. In general, the

smaller the value of S, the faster the speed.

- Line 260 (FOR I = 36 to 4, STEP – 1) moves the ship across the screen and sets the game space. To give yourself more time to react to a UFO as it appears on the screen, change the 36 in the expression to a smaller value.
- Line 270 (O = RND(3) – 1) determines the character of the evasive action that the ships make as they move across the screen. Increasing the value of variable O will enlarge the vertical excursions that the ships make as they move across. It will also make them more difficult to hit.
- Line 250 (E = RND(14) + 1) sets the color of each UFO. To fix the color just set the variable E to the proper Apple II color value.
- The variable Y in line 240 (Y = RND(37)) sets the vertical position where the UFO appears on the screen. The rest of the statement confines the positions to lie between Y values of 5 and 34. Expanding the vertical boundaries won't work too well because the ship graphics fall off the screen. You can narrow the boundaries, though, and confine the possible places where UFOs appear.

If you can think of ways to improve the game and keep it within its 8K limit, let's hear about them. ■

```
150 PRINT
160 VTAB 15: TAB 10: INPUT "HIT RETURN WHEN READY ";A$
170 CALL -936: VTAB 13: TAB 13: PRINT "HERE THEY COME...": FOR
    L=1 TO 2000: NEXT L
180 U=0:G=0:Z=0:T=0:Q=0: CALL -936: GR
190 VTAB 23: PRINT "U.F.O.S HIT :";
200 TAB 25: PRINT "SCORE:";
210 FOR L=1 TO 20
220 S= RND (2)+1
230 R= RND (3)+1
240 Y= RND (37): IF Y<5 THEN Y=5: IF Y>34 THEN Y=34
250 E= RND (14)+1
260 FOR I=36 TO 4 STEP -1
270 O= RND (3)-1
280 COLOR=15:X= PDL (0)/7:Q2= PDL (1): IF Q2>210 THEN Q2=210:Z=
    Q2/7: PLOT Z,X
290 FOR P=1 TO S*2
300 COLOR=E: GOTO R*20+290
310 PLOT I-1,Y-O: PLOT I+1,Y-O: PLOT I,Y-O+1: PLOT I,Y-O-1
320 GOTO 360
330 PLOT I+1,Y-O+1: PLOT I-1,Y-O+1: PLOT I-1,Y-O-1: PLOT I+1,Y-O-1
340 GOTO 360
350 PLOT I+1,Y-O-1: PLOT I+1,Y-O+1
360 COLOR=9: PLOT I,Y-O
370 NEXT P
380 COLOR=0: GOTO R*20+370
390 PLOT I-1,Y-O: PLOT I+1,Y-O: PLOT I,Y-O+1: PLOT I,Y-O-1
400 GOTO 440
410 PLOT I+1,Y-O+1: PLOT I-1,Y-O+1: PLOT I-1,Y-O-1: PLOT I+1,Y-O-1
420 GOTO 440
430 PLOT I+1,Y-O-1: PLOT I+1,Y-O+1
440 PLOT I,Y-O
450 PLOT Z,X
460 IF X=Y-O AND I=Z THEN 490
470 NEXT I
480 GOTO 615
490 G=G+1:W=(I/S): IF W=0 THEN W=1:T=W:Q=Q+T:W=(30/S):U=U+W
540 TAB 14: VTAB 23: PRINT "";
550 FOR K=1 TO 3
555 K1=40:I1=5
556 POKE 0,I1: POKE 1,K1 MOD 256: POKE 24,K1/256+1: CALL 2
560 COLOR=9: PLOT I-K,Y-O-K: PLOT I+K,Y-O+K: PLOT I-K,Y-O+K: PLOT
    I+K,Y-O-K
564 K1=40:I1=5
565 POKE 0,I1: POKE 1,K1 MOD 256: POKE 24,K1/256+1: CALL 2
570 COLOR=0: PLOT I-K,Y-O-K: PLOT I+K,Y-O+K: PLOT I-K,Y-O+K: PLOT
    I+K,Y-O-K
575 K1=40:I1=5
580 POKE 0,I1: POKE 1,K1 MOD 256: POKE 24,K1/256+1: CALL 2
600 NEXT K
610 PRINT G;: TAB 31: PRINT T;" "
615 FOR I=1 TO RND (400)+100: NEXT I
620 NEXT L
625 TEXT : CALL -936: VTAB 10: TAB 11: PRINT "U.F.O.S HIT : ";G:
     VTAB 12: TAB 6: PRINT "HIGHEST POSSIBLE SCORE : ";U: VTAB
    14: TAB 11: PRINT "YOUR SCORE : ";Q
630 VTAB 16: TAB 13: PRINT "OR ";(Q*100)/U;" %"
635 VTAB 18: TAB 7: INPUT "HIT RETURN TO PLAY AGAIN ",A$
637 IF A$="" THEN 180
640 END
```


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Super Word Processors

After presenting a brief introduction to "word processing," this author takes a look at four word processing systems: EDIT and PR; Electric Pencil; Word-Star; and the Magic Wand.

Rod Hallen
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If the volume of letters and telephone calls that I receive is any indication, word processing is the most popular microcomputer subject with hobbyists and businessmen. It is also one of the easiest computer applications to implement—training periods are short, and it is possible to turn out first-class documents almost from the very beginning.

There are many word-processing systems on the market, and more are appearing every day. However, this popularity creates some problems. How can you tell from an advertisement or a brochure whether a particular word-processing software package is right for you?

The truth is, you can't! There are just too many variations in features, operation and price. The closest way to tell is to read the instruction manual that comes with the package. Another way to gather more information is to read the hardware and software reviews in microcomputer magazines. (See references at the end of this article.)

Background

Word processing involves the creation, revision and printing of documents, whether they are letters, manuscripts, reports or any other printed material. A strict definition of word processing does not necessarily include the use of a computer. The simplest definition would be "the compilation of words into a form suitable for reading." Anything in addition to that is window dressing . . . important window dressing.

A computerized word processor provides significant advantages. The first is the ease with which the document can be created. The initial step is similar whether a computerized or non-computerized system is used. A typist sits down at a computer keyboard or at a typewriter and enters the desired text from his head or from a dictated copy. At this point the results may or may not be the same, depending upon the ability of each typist.

The typewriter user must exercise extreme care with his typing, since he is producing the final copy. Many different methods of correcting typing errors have been developed, and while some are more efficient than others, none are perfect. None of these methods will allow the erasure of a three-letter word and its replacement with a six-letter word.

The computer user, on the other hand, has his text on a video screen and can make as many changes or corrections as he likes. Words, sentences or even whole paragraphs can be deleted, added or changed. Blocks of words can also be moved from one point in the document to another. While no two word-processing software packages have all of the same features, the watchword is flexibility.

Another advantage that the computer user has over the conventional typist is ease in creating duplicate letters. A computer can fashion a form letter with blank spaces for the date, name and address, salutation and personal remarks and then print copies from it. Each will seem quite personalized.

A data file of standard paragraphs can be stored on tape or disk, and composite letters or manuscripts printed from them. Without the computer each letter must be manually typed one at a time.

The appearance of a document can also be important. Variables such as headings, margins, spacing, justification and other print values contribute to the overall appearance of the document. Without a video screen it is difficult to judge how the document will look in its finished form or make any necessary adjustments.

With a microcomputer word processor you can dump a copy, check it out, change print values and dump again. This process can continue until you get exactly what you want, although after a little experience you will know ahead of time which print values are most likely to produce the desired results.

Text Editors and Formatters

A text editor is a program that accepts input from the keyboard or from tape or disk storage and then displays that text input on the video screen for review and/or revision. The result can be saved back to tape or disk. A text formatter takes the output of the editor, formats it in the desired way and sends it to a hard-copy device. Some word processors combine the editor and formatter into one package.

Every BASIC or assembly-language operating system has a text editor of some kind; most are primitive and are generally suitable only for entering and changing program listings. Disk operating systems usually contain text editors, which are usually a step or two higher in utility.

ED, which is a part of the CP/M package available from Digital Research, PO Box 579, Pacific Beach CA 93950, can be used to generate program source listings and also to create text files for use by various formatters. CP/M's own text formatter is called

TEX. However, ED is based on a serial hard-copy terminal rather than a video screen and is not the easiest to use when generating text.

While the word-processing software that will be discussed from here on out is CP/M compatible, the same remarks will apply in general to software which is based on most other operating systems. I chose CP/M as the software base for my microcomputing system because of its popularity and availability of software to run on it.

EDIT and PR

EDIT and PR are a text editor and text formatter from Technical Systems Consultants, Inc., PO Box 2570, West Lafayette IN 47906. EDIT is similar to CP/M's ED in many ways, but it provides an easier method of editing.

PR is one of the most capable text formatters on the market. It has features that no other currently available processor can match. A Macro command facility allows the user to create and save on disk many differently named print value formats. Any desired format can then be invoked by calling its name. A useful Macro library is included in the well-written instruction manual.

Variables can be established in a manner similar to the way they are used in a BASIC program. These variables can then be tested at any time during the printing of a document with an IF . . . THEN-type statement and print value determination decisions made. This is extremely useful and provides for flexible formatting capability.

Messages can be displayed on the screen at any time during the printing of a document. These messages can be used to instruct the operator to insert a new sheet of paper or change the print element, or they can request input such as the date, a name and address or other information for inclusion in the document from the keyboard. Footnotes and form letters are handled easily.

An unusual feature of EDIT and PR is that a complete source listing of both programs is contained in the manuals. This should be of interest to software hackers who insist on modifying software to make it fit their own personal requirements.

One shortcoming of PR is its use of ED or EDIT to create the text file; a video-oriented editor would be much better. I am using the Imsai VIO video interface board, which provides both character insert and delete in software. It should be possible to mate this to EDIT using the source listing.

Another unusual feature of EDIT and PR is their low prices . . . much lower than just about any other word-processing software. They are well within the range of most hobbyists.

Electric Pencil and Pencil Sharpener

The next step up the ladder is the Electric Pencil from Michael Shrayer Software, 1253 Vista Superba Drive, Glendale CA 91205. I have used the Electric Pencil for two years with good results. The Pencil combines both editor and formatter in one program in an easy-to-use manner.

Its major drawback is that it will only work with memory-mapped video interface boards. This requirement eliminates video terminal users. Most of the manufacturers of the video boards that the Pencil supports have recently gone out of business. Also, it does not make any provision for the filling in of form letters other than one by one.

The best feature of the Pencil is its screen-oriented editing method. When you want to make changes in the text, the desired part is brought to the screen, the cursor is moved to the point of change, and the corrections are typed. If characters are being inserted, the rest of the text moves out to make room. If characters are being deleted, the rest of the text moves back to fill in the blanks. You always know exactly what the final wording will look like.

A new program called the Pencil Sharpener for use with the Electric Pencil is being marketed by Micro Data Systems, PO Box 36051, Los Angeles CA 90036. As you might guess from its name, the Pencil Sharpener is designed to enhance the Electric Pencil. It provides the Pencil with complete form-letter facilities. A list of names, addresses and other pertinent data can be maintained as a disk file, and form letters can be printed to any or all list entries.

Just about any text-editing facility can be used to create the data list, which determines to whom form letters will go and how they will be filled in. If a high-level programming language such as BASIC is used, then it can be useful in making selections from a large data base, making calculations and decisions on the data and sorting using various keys. A program could also be written in BASIC to prompt the user via the video screen for the proper entries to create the data file.

The Sharpener uses the Pencil Search and Replace feature to insert items from the data file into the form letter. If the data file contains more than one set of data items, then a letter will be printed for each set. All of this takes place on the screen exactly as if you had entered all of the information from the keyboard, except that it happens much faster.

One unusual feature of the Sharpener is the lack of an instruction manual. Instead, the master disk contains information files, which can be read on the screen or printed out if you want a hard copy. Otherwise, you would have to stop in the middle of an editing session to reload the instruction file, if you had a question about the implementation of some function.

Creating all of the files necessary to make complete use of the Pencil Sharpener takes quite a bit of time, and it probably won't be worth it to someone who only writes a few form letters each month. But if your operation requires that a great many letters or contracts be filled in, then the time spent will be well worthwhile. Those now using the Pencil and falling into this category should have a look at the Sharpener.

> **"The computer user has his text on a video screen and can make as many changes or corrections as he likes."**

Word-Star

A new generation of word-processing software, which I call the Super Word Processors, is now emerging. Word-Star from MicroPro International Corporation, 1299 Fourth Street, San Rafael CA 94901, is a good example.

Word-Star will work with just about any video terminal in a rather unique manner. The first time that W-S is loaded, you are presented with a list of video terminals and memory-mapped video interface boards and are asked to indicate which one you are using. W-S will then configure itself for your particular equipment layout. You can then dump this new copy to disk, which will be your working copy. If you change terminals, you can go back to the master disk and make a new work copy.

All of the most popular video equipment is included in this patching dialog. Information for patching terminals not in the list is also given in the manual. This means that you don't have to send your master disk back to the vendor whenever you change

equipment. A particular version of the Electric Pencil, for instance, will only work on the equipment for which it was written.

W-S will allow you to create, revise and print a text file whose size is limited only by the amount of vacant space available on the disk by bringing part of the file into a memory work buffer for review or revision. This can then be sent back to the disk (or another disk) and the next part of the file brought in. This continues until the entire file has been scrolled through the work buffer. You then have two files on disk. The original file will have its filetype changed to BAK, and the edited file will carry the filename and type of the original. This provides automatic backup capability.

Since W-S requires 44K of RAM to operate, this disk file scrolling is important. The Electric Pencil, on the other hand, will only handle files that are wholly contained in memory, but since the Pencil only occupies a few thousand bytes, a large file can be held in a 44K system.

W-S is a complex program with a long list of possible commands, which are well explained in the instruction manual that is part of the package. A condensed command summary sheet also helps in this regard.

However, a major feature of W-S is its command menus. In normal operation a command menu is always displayed at the top of the screen during an editing session. This menu, which is in reverse video for ease of visually separating it from the text being worked on, lists the main commands and their meaning. Four other menus listing more commands can also be called to the screen at any time. This is helpful to the user as he is getting used to the system, but these menus take up as much as half of the screen, which means that less room is available for the text being created or revised.

The designers of W-S have taken this into account with the addition of Help Levels. As the operator becomes more familiar with the commands, he can decide exactly how much help he needs by selecting one of four Help Levels. The lowest Help Level will eliminate all menus and leave the entire screen except for the top two lines available for editing. These two lines indicate the page, line and column number of the cursor location plus the length and tab settings within the line.

Most text editors fill the screen completely with text, and you have to wait until it is dumped to a hard-copy device to see the formatted result. W-S lets you see the line length, justification and even the page breaks. You can then change any or all of these before printing.

As with all other word processors, you can specify the print values that will create the desired appearance of the hard copy either before printing or within the body of the file. If you choose not to indicate print values, then a standard set that prints a normal 8½ × 11 inch page will be used.

W-S is flexible when it comes to merging files and creating form letters. Stock letters or paragraphs can be maintained on disk and then called up as required. One file can be inserted into the middle of another, or many files can be combined to produce the desired output.

> **“Of all the word processors I have used, the Magic Wand is the most versatile.”**

Facilities are provided for output to a high-speed dot matrix draft printer and/or to a quality printer such as the Diablo or Spinwriter. This allows you to quickly print a document so that the originator can review it. When it appears in acceptable form, a final copy can be printed on the quality printer. Most such printers support W-S's boldface, underlining and sub or superscript printing.

The Magic Wand

Of all the word processors I have used (and that includes a dozen or more), the Magic Wand is the most versatile. The Wand has almost all of the features of other processors, plus many new ones of its own. It measures up to even the word-processing software running on the largest mainframe computers.

Since the Wand consists of two programs, EDIT and PRINT, it can run in a much smaller amount of memory than Word-Star can. EDIT also contains a simple print module that allows you to dump a file to the printer for review purposes without having to load the PRINT program. A document printed in this manner will not be formatted in the way that the final copy will, but it will allow the originator to check for spelling or information errors.

While at the present time the Wand must be configured for your particular equipment layout, its designers, Small Business Applications, Inc., 3220 Louisiana, Houston TX 77006, are working on a flexible terminal-patching arrangement similar to Word-Star's. In the meantime, just about any video terminal or board is supported by SBA. The same applies to most of the better quality printers.

The first part of the Magic Wand instruction manual contains a series of nine lessons intended to familiarize the user with all of the features and commands at his disposal. The second part of the manual contains a more detailed explanation of each of these features and commands. All in all, a well-done documentation job.

Like many word processors, the Wand can handle files whose size is limited only by the amount of vacant disk space. The part of the file that has been brought into the work buffer can be scrolled line by line or screen by screen for review or revision. Or, if you know exactly what you are looking for, the Search function can bring the desired portion of the text to the screen immediately. Editing is in true screen-oriented fashion like the Electric Pencil and Word-Star.

One especially nice feature is a Full Insert command. With the Pencil or W-S, when an insertion is being made in the middle of the sentence, you will notice that there is a measurable amount of time required to move the following text to make room for the insertion. If a great deal of text must be moved with the Pencil, it is possible to lose characters if you type too fast. The Wand's Full Insert command breaks the sentence at the point of insertion and moves the following text to the bottom of the screen. You can then insert as fast as you like and then close up the text when you are finished.

Two different displays are available during the operation of the Wand. The Command Screen tells you the name of the file or files being worked on, the number of characters being used and the number of vacant spaces left in the work buffer. It also tells you whether you are in Text or Program mode, what line length is being used and where the tab stops are set. Program mode is used to generate source listings for assemblers or higher-level languages such as BASIC.

Files are saved to disk or dumped to the printer from the Command Screen. You can also display the disk directory for any online drive. One especially useful feature is the ability to look at the contents of any file on any disk while you are in the midst of editing. This means that you can stop in the middle of an edit session, go to the Command Screen, call for a directory listing and then display on the screen the contents of any disk file. You can use this function to search files for blocks of text that you

would like to incorporate into the current file.

The second display is the Text Screen, where you enter or edit text. You can switch back and forth between Text and Command Screens at will.

The Magic Wand provides Ghost Hyphenation, which allows you to put conditional hyphens in long words for line justification. If the word falls at the end of a line and needs to be broken, it will be hyphenated. If it doesn't need to be broken, no hyphen will appear in the final copy.

It is in the area of form letters that the Magic Wand really casts its spell. Complete letters can be made up ahead of time and then sent to all or any selected names of a mailing list. Conditions can be set up and tested to see who gets which letter. For instance, you might have come up with a new product that will appeal only to previous customers who had already purchased a specific item from you. You would only want these people to receive a description of the new product.

Stock paragraphs and letters can be created and stored on disk. Each paragraph or letter would be assigned a code. You might indicate to the Wand that you wanted to type a letter that was composed of paragraphs A-3, M-2, S-7 and X-4. With a large and varied selection of paragraphs, you would have a complete letter-writing system that would produce personal-sounding letters. You must, however, make sure that the selected paragraphs are actually pertinent to the subject at hand.

A powerful IF . . . THEN feature and the use of variables very much like those in BASIC programming combine to provide an almost unlimited range of word-processing control. Variables can be named, given values, incremented or decremented and tested. Decisions about print functions or values can be made on the basis of these tests.

If you wished to address form letters from the keyboard, you'd set up a printing loop. The form letter would have GET commands, i.e., GET DATE, GET NAME, GET ADDRESS, etc., embedded in it. The Wand would interrogate the operator each time that a GET command was encountered, and the operator would then supply the desired input. As soon as one letter was completed, the Wand would go back and start another one. It would continue this loop until told to stop.

The PRINT portion of the Magic Wand is the text formatter, which will support both a high-speed draft printer and a quality impact printer. The Wand can control the horizontal and vertical movements of these quality printers within small fractions of an inch. As many or as few characters can be printed per inch as desired. Lines can be justified by inserting spaces between words or fractional spaces between every single character. Sub and superscripting is accomplished by moving the paper vertically in small increments.

Boldface printing stands out and can be used to highlight words to which you want to draw attention by striking the letter, moving the printhead and striking the letter again. You can select from one to nine overstrikes for as much emphasis as you like. Underlining can also be used for the same purpose.

Conclusion

All word processors provide certain basic features. I have tried to point out how W-S and the Wand go beyond the basics to make word processing easier and more profitable.

Word-Star and the Magic Wand are both outstanding examples of the new levels of software that are being written for the small businessman, although I can't imagine a business of any size that couldn't use software of this quality. They are, of necessity, both complex, as reflected in their prices. Because of this they will probably not appeal to the hobbyist who uses his microcomputer to write a few personal letters; they will be of much more interest to the author or businessman who works with words on a regular basis. ■

References

Kilobaud Microcomputing

issue	page	title
Jun 78	60	Malibu 160
Aug 78	22	DOCUFORM
Dec 78	62	TSC text editor
Feb 79	110	Text/document prep made easy
Mar 79	96	Teletype Model 43
Mar 79	114	The Electric Pencil
May 79	26	Text Formatter in BASIC
Sep 79	92	Word processing systems

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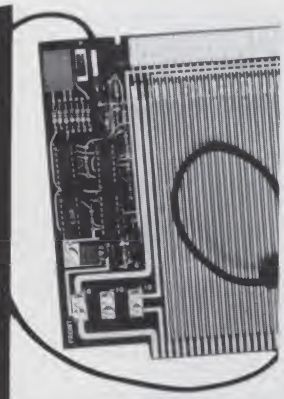
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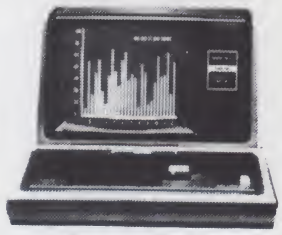
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Two subroutines for "Micromonitor for MIKBUG," which appeared in last month's issue.

```
00010                           NAM     CALBRA
00020                   *CALCULATE BRANCH SUBROUTINE
00030                   *INPUT "FROM" ADDRESS, "TO" ADDRESS
00040                   *CALBRA WILL PRINT DISPLACEMENT IN HEX
00050                   *TYPE A "@" TO EXIT TO MICROMONITOR
00060                   *WRITTEN BY DAVE TIETZ 6/20/77
00070                           OPT     O
00080        E067       OUTHL   EQU     $E067
00090        E06B       OUTHR   EQU     $E06B
00100        2F71       CRLF    EQU     $2F71
00110        2F80       BADDRM  EQU     $2F80
00120        2F50       START   EQU     $2F50
00130        2F88       INEEM   EQU     $2F88
00140                   *
00150 2F15                      ORG     $2F15
00160                   *
00170 2F15 8D 08        CALBRA  BSR     INTST   TEST FOR "@"
00180 2F17 8D 0F                BSR     GET2    GET "FROM" & "TO" ADDRESSES
00190 2F19 80 02                SUB A   #$02    ADJUST FOR PROGRAM COUNTER
00200 2F1B 8D 2B                BSR     OUTA    PRINT BRANCH
00210 2F1D 20 F6                BRA     CALBRA  LOOP
00220                   *
00230                   *TEST 1ST CHAR, DO BRANCH CALC IF NOT "@"
00240                   *
00250 2F1F 8D 50        INTST   BSR     CRLF    CARRIGE RETURN LINE FEED
00260 2F21 8D 65                BSR     INEEM   GET 1ST CHAR
00270 2F23 81 40                CMP A   #$40    TEST FOR "@"
00280 2F25 27 29                BEQ     START   USER WANTS BACK TO MICROMON
00290 2F27 39                   RTS             USER HAS ANOTHER BRANCH TO DO
00300                   *
00310                   *GET "FROM" AND "TO" ADDRESSES
00320                   *
00330 2F28 8D 56        GET2    BSR     BADDRM  GET "FROM" ADDR
00340 2F2A DF 02                STX     $02     STORE A 0002,3
00350 2F2C 8D 52                BSR     BADDRM  GET "TO" ADDR
00360 2F2E DF 00                STX     $00     STORE AT 0000,1
00370                   *
00380                   *DO ARITHMETIC (SUB 0002,3 FROM 0000,1)
00390                   *
00400 2F30 73 0003      SUB01   COM     $0003   MAKE 0003
00410 2F33 73 0002              COM     $0002   AND 0002
00420 2F36 86 01                LDA A   #$01    TWO'S
00430 2F38 5F                   CLR B           COMPLEMENT
00440 2F39 9B 03                ADD A   $03     NUMBERS
00450 2F3B D9 02                ADC B   $02
00460 2F3D 73 0003              COM     $0003   RESTORE
00470 2F40 73 0002              COM     $0002   0002 AND 0003
00480 2F43 9B 01                ADD A   $01     ADD 2'S COMPLMNT 0002,0003
00490 2F45 D9 00                ADC B   $00     TO 0000,1
00500 2F47 39                   RTS             RETURN
00510                   *
00520                   *PRINT HEX CONTENTS OF ACC A
00530                   *
00540 2F48 36           OUTA    PSH A           SAVE FOR OUTHR
00550 2F49 BD E067              JSR     OUTHL   PRINT LEFT HEX
00560 2F4C 32                   PUL A           RESTORE A
00570 2F4D 7E E06B              JMP     OUTHR   PRINT RIGHT HEX AND OUT
00580                           END
```

Calbra program.

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Last month I described a short 6800 machine-language program, Micro Monitor, that works with MIKBUG. It provided some improved memory-handling features and a Subroutine Test command, which, I mentioned, could be used to expand the basic program.

In this article, I will describe two handy "expansions." Either one is entered using the "S" command and returns to Micro Monitor when you want.

The first is a branch-calculating subroutine, *Calbra*. Given a "from" address and a "to" address, Calbra will print either forward or backward the hexadecimal displacement of any

```
*M A048
*A048 2F
*A049 50
*G
@2F15 S
 2F53 2F71 1C
 2F57 2F85 2C
 2F6B 2F53 E6
 2FD4 2F71 9B
@
@*
*
```

Listing 1. Calbra sample run.

```
*M A048
*A048 2F
*A049 50
*G
@0100  010F
0100  75 75 71 79 71 75 21 79  79 75 75 71 31 78 B9 A1
@0200  020F
0200  8E 8A 8E 82 82 8A 8A CA  8E 8A 8E 8A 8E 8A 8E 8A
@0300  030F
0300  39 31 31 31 3D 75 79 75  79 75 71 F1 70 79 F1 31
@2EE1 S
 0100 0300 010F 030F
 0300 0200 030F 020F
@
@0100  010F
0100  75 75 71 79 71 75 21 79  79 75 75 71 31 78 B9 A1
@0200  020F
0200  75 75 71 79 71 75 21 79  79 75 75 71 31 78 B9 A1
@0300  030F
0300  75 75 71 79 71 75 21 79  79 75 75 71 31 78 B9 A1
@*
*
```

Listing 2. Movdat sample run.

branch operation. The second is a memory relocation subroutine, *Movdat*. Given a "from" address, a "to" address and a "stop at" address, Movdat will move any amount of memory to a new location. It will then tell you the new location of the last byte moved, so you know the exact limits of the new location of your program.

Both are dependent on Micro Monitor's being present since they use some of the same subroutines. Calbra occupies memory immediately below Micro Monitor, and Movdat resides below Calbra. In my system the respective addresses (all addresses and data are hexadecimal) are Movdat 2EBD to 2F14, Calbra 2F15 to 2F4F and Micro Monitor 2F50 to 2FEE. Calbra, like Micro Monitor, is relocatable without change; Movdat requires only two addresses (four memory locations) to be changed.

Before I go on to describe the operation of these subroutines, I should describe *Intst*, a subroutine in Calbra that Movdat also uses to return back to Micro Monitor. Intst resides between 2F1F through 2F27, and if you look at the listing, the comments should explain its operation. While in either subroutine, and before any data has been entered, Intst looks for a "@" to be entered for the return. Any other character is ignored, and the address inputs may be entered.

Calbra Operation

Listing 1 illustrates a typical run using Calbra. After making sure MIKBUG's program counter has Micro Monitor's starting address in it, I typed "G," which brings back a "@" (Micro Monitor's prompt). I then typed "2F15" (Calbra's entry point); Micro Monitor inserted the space; and I entered "S" (subroutine command). Intst prompted the CR, LF and looked for the "@." I typed a "space" to move out of Intst and then entered *from* address "2F53." Calbra inserted the space; I entered *to* address "2F71" and Calbra inserted another space; then Calbra printed the displacement "1C;" and Intst gave the CR, LF etc.

I continued for three more branch values and then went back to Micro Monitor by entering the "@." These are both forward and backward values chosen from Micro Monitor. Check these values with the Micro Monitor listing. Notice the address entries are from *Instruction* to *Instruction*.

Calbra will not give an error message on forward branches more than 7F, or backward branches over 80. It's up to you to check for these conditions. If you make an error in entering an address, you can easily rectify the mistake by entering a non-hex value, which causes a jump back to MIKBUG, entering the "G," the "2F15 S" and redoing your entry. The same applies to Movdat.

Movdat

Listing 2 illustrates the use of the Movdat subroutine. I used Micro Monitor to get three memory dumps—one from 0100 to 010F, another from 0200 to 020F and the last from 0300 to 030F. I then entered Movdat by inputting "2EE1" "S" and hit the space bar to get past Intst.

I then moved data *from* "0100" to "0300" *stopping at* "010F." The *last address* in the new location was 030F, a forward move. I then made a backward move (after again getting past Intst with a "space") *from* "0300" to "0200" stopping at "030F;" the last address was 020F.

Now I satisfied Intst with a "@" and returned to Micro Monitor. I again received the memory dumps, which verified that the moves took place.

Movdat will move any amount of memory to any place there is memory. You can also move data one location forward or backward to insert a byte. Again, for the sake of keeping the programs compact, there are no error messages; you must be aware of what you are doing.

Movdat is a "self modifying" program. It decides whether the move is forward or backward and sets up an increment

Movdat program

```
00010                        NAM    MOVDAT
00020                   *FROM MICRO MONITOR ENTER "2EE1", "S"
00030                   *ENTER "SPACE", "FROM ADDR", "TO ADDR",
00040                   *AND "STOP ADDR", TERMINAL WILL PRINT
00050                   *END ADDR OF LAST BYTE NEW PROGRAM LOCATION
00060                   *ENTER A "@" TO GET BACK TO MICRO MONITOR
00070                   *NEEDS MICRO MONITOR AND CALBRA TO RUN
00080                   *WRITTEN BY DAVE TIETZ 7/15/77
00090                        OPT    O
00100 2EBD                   ORG    $2EBD
00110       E0C8    OUT4HS EQU    $E0C8
00120       2F80    BADDRM EQU    $2F80
00130       2F1F    INTST  EQU    $2F1F
00140       2F28    GET2   EQU    $2F28
00150                   *
00160                   *FORWARD MOVE ROUTINE
00170                   *
00180 2EBD DE 02    FORW   LDX    $02       GET "FROM" ADDR
00190 2EBF 09              DEX              AND MAKE
00200 2EC0 09              DEX              "STOP" ADDR
00210 2EC1 DF 04           STX    $04       STORE AT "STOP" REGISTERS
00220 2EC3 36              PSH A            SAVE ACCA
00230 2EC4 37              PSH B            AND ACCB
00240 2EC5 8D 4C           BSR    BADDRX    CALL "STOP" ADDR
00250 2EC7 DF 02           STX    $02       STORE AT "FROM" REGISTERS
00260 2EC9 33              PUL B            RETRIEVE ACCB
00270 2ECA 32              PUL A            AND ACCA
00280 2ECB 9B 03           ADD A  $03       ADD DISPLACEMENT
00290 2ECD D9 02           ADC B  $02       TO "FROM" VALUE
00300 2ECF 97 01           STA A  $01       AND STORE AT
00310 2ED1 D7 00           STA B  $00       "TO" REGS
00320 2ED3 97 07           STA A  $07       SAVE FOR
00330 2ED5 D7 06           STA B  $06       PEND ROUTINE
00340 2ED7 86 09           LDA A  #$09
00350 2ED9 8D 1D           BSR    MOD       MODIFY PROGRAM
```

```
00360                    *
00370                    *PRINT END ADDR IN 0006,7
00380                    *
00390 2EDB CE 0006 PEND  LDX    #$0006   POINT IXT AT END ADDR REGS
00400 2EDE BD E0C8       JSR    OUT4HS   PRINT LAST MEM LOC LOADED
00410                    *
00420                    *MOVE DATA START*********
00430                    *
00440 2EE1 8D 3C   MOVDAT BSR    INTST    CHECK FOR "@" (END)
00450 2EE3 8D 43          BSR    GET2     GET "FROM", "TO" AND SUB
00460 2EE5 2A D6          BPL    FORW     BRANCH IF POS (FORWARD MOVE)
00470                    *
00480                    *BACKWARD MOVE ROUTINE
00490                    *
00500 2EE7 8D 2A          BSR    BADDRX   CALL "STOP" ADDR
00510 2EE9 08             INX             ADJUST ADDR
00520 2EEA 08             INX             FOR TEST
00530 2EEB DF 04          STX    $04      STORE "STOP"
00540 2EED 86 08          LDA A  #$08
00550 2EEF 8D 07          BSR    MOD      MODIFY PROGRAM
00560 2EF1 DE 00          LDX    $00      GET LAST LOAD
00570 2EF3 09             DEX             ADJUST BACK
00580 2EF4 DF 06          STX    $06      STORE AT END REGS
00590 2EF6 20 E3          BRA    PEND
00600                    *
00610                    *MODIFY PROGRAM FOR INC OR DEC IXR
00620                    *
00630 2EF8 B7 2F02 MOD    STA A  HERE     1ST LOCATION
00640 2EFB B7 2F0E        STA A  THERE    2ND LOCATION
00650                    *
00660                    *MOVE DATA "FROM" ADDR IN 0002,3
00670                    *"TO" ADDR IN 0000,1
00680                    *TEST FOR AT "STOP" ADDR IN 0004,5
00690                    *
00700 2EFE DE 02   MOVE   LDX    $02      IXR POINT AT "FROM"
00710 2F00 A6 00          LDA A  00,X
00720 2F02 01      HERE   NOP             INX OR DEX
00730 2F03 9C 04          CPX    $04      AT STOP YET?
00740 2F05 26 01          BNE    ON       NO GO ON
00750 2F07 39             RTS             YES, DONE
00760 2F08 DF 02   ON     STX    $02      UPDATE "FROM" REGS
00770 2F0A DE 00          LDX    $00      POINT AT "TO"
00780 2F0C A7 00          STA A  00,X     STORE
00790 2F0E 01      THERE  NOP             INX OR DEX
00800 2F0F DF 00          STX    $00      UPDATE "TO" REGS
00810 2F11 20 EB          BRA    MOVE     MOVE NEXT LOCATION
00820 2F13 20 6B   BADDRX BRA    BADDRM   BRANCH ISLAND TO MICRO MON
00830                     END
```

or decrement condition for the "from/to" address pointer (index register). The IXR or DEX instructions are stored at absolute addresses 2F02 and 2F0E at my location for Movdat. These addresses are referenced by 2EF9, 2EFA and 2EFC, 2EFD. These are the four memory locations you must change if you relocate the program.

One Final Point

Memory locations 0000 through 0007 are altered when using Movdat. I have adopted the philosophy of reserving the bottom ten memory locations for "scratch pad" for all my routines. My three programs can be rewritten to use other areas of memory, but they will require more memory themselves. All three routines occupy a total of 305_{10} bytes and, together with MIKBUG, provide versatile memory-handling capabilities.

You should find these to be handy routines, especially for program "patching." I hope they save as much time for you as they have for me. ■

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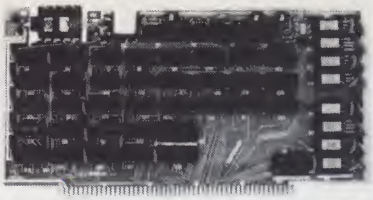
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Info: The Greater Lafayette Apple User Group, Jon Backstrom, Digital Technology, 10 North Third, Lafayette IN 47901.

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Where: Albany Junior College, Albany GA.
When: Second Sat. of each month.
Info: Albany Computer Society, c/o Dr. Donald Cook, 2400 Gillionville Rd., Albany GA 31707.

(continued on page 226)

CALENDAR

New York NY
"Languages and Tools for Microcomputing" will be the subject of a conference sponsored by *Byte* magazine on June 16–17, 1980, at McGraw-Hill headquarters in New York City. For further information, contact McGraw-Hill Conference and Exposition Center, Room 3677, 1221 Avenue of the Americas, New York NY 10020, or call (212) 997-4930.

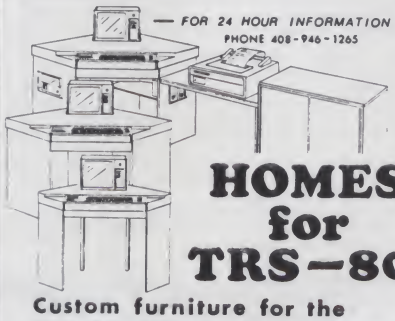
Guelph Ontario
Central Ontario Amateur Radio Flea Market and Computer Fest, Centennial Arena, College Ave. West, Guelph Ontario, Saturday, June 7, 1980, 8 AM to 4 PM. Admission only $1 (12 years and under—free). For further information, please contact Rocco Furfaro VE3HGZ, (519) 824-1157.

Blacksburg VA
Workshop: TRS-80 Interfacing and Programming for Instrumentation and Control. June 23–27, 1980. This is a hands-on workshop with the participants working with and designing interfaces for the TRS-80. For more information, contact Dr. Linda Leffel, CEC, Virginia Tech., Blacksburg VA 24061, (703) 961-5241.

Champaign IL
An update review of existing technology and recent advances will be presented at the Ninth Annual Symposium on Incremental Motion Control Systems and Devices, June 2–5, 1980, Ramada Inn, Champaign, Illinois. For further information, contact Professor B. C. Kuo, IMCSS, PO Box 2772, Station A, Champaign IL 61820, (217) 333-4341.

Santa Barbara CA
Computer Camp is being held this summer at Rancho Oso, in the mountains behind Santa Barbara. There will be five two-week sessions beginning June 22 for children 10–15. For information and application form please write or call Computer Camp, 1235 Coast Village Road, Suite G, Santa Barbara CA 93108, (805) 965-7777.

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LETTERS

(from page 20)

That may mean a return to the academic problems I am still interested in, or working for a larger company in this industry where I would have the resources to really do something.

Timothy W. Collins
Raleigh NC

It is difficult, Timothy. Dealers have to have enough cash on hand to invest in inventory. With most of the manufacturers either on a short cash tether or else wary of underfinanced dealers, credit is almost nonexistent. But then, even the Radio Shack stores get no credit, so you are on the same basis as everyone else. This situation isn't bad when you can get fast delivery on needed systems, but if you have to wait a few weeks, or months, it can kill you—no one can survive that! You might think about writing articles about your experiences, with ideas for dealers that will help them avoid some of the miseries you went through—Wayne.

Lowercase with BASIC

I like Steve Wexler's April 1980 article on lowercase letters for the TRS-80, but I use a couple of lines of BASIC, rather than machine language, to use it. So far it's worked fine.

When I turn on the power, I set the memory size to leave 96 free bytes at the end of memory. Then, in whatever program needs lowercase letters, I add a couple of lines to copy Radio Shack's video driver logic, wipe out the instructions that wiped out my lowercase printing and add an exclusive-OR instruction to "reverse" the shift keys, printing lowercase for upper, and uppercase for lower.

It's short and simple, and it works. Fig. 1 shows the BASIC statements needed to do it all.

Ronald Foulis
Jacobus PA

Set memory size to 20384 for 4K, 32672 for 16K machines. In your program, before you need to "print" lowercase:

```
FOR X=0 TO 95: POKE X+20384, PEEK(X+1112):
    NEXT:
FOR X=20413 TO X+7: POKE X,0: NEXT: POKE
    X-2,238:
POKE 16414,160: POKE 16415,79
```

To "reverse" the shift keys, POKE 20420,32.
To go back to normal shift keys, POKE 20420,0.
To go back to Radio Shack's video driver logic,
POKE 16414,88: POKE 16415,4.
For 16K machines, add 12288 to 20384, 20413 and 20420 above.

Fig. 1. Lowercase using TRS-80 BASIC.

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✓Reader Service—see page 257

(CLUBS, from page 224)

South Carolina Apple
Where: The Byte Shop, Blossom St., Columbia SC.
When: 7:30 PM, the second Tues. of each month.
Info: South Carolina Apple, Felix Clayton, President, 1610 Longview Rd., Mount Pleasant SC 29464.

Connecticut Computer Club
Where: Suffield CT Library.
When: 7:30 PM, the first Thurs. of each month.
Info: Leo Taylor, 18 Ridge Court West, West Haven CT 06516.

Evansville Computer Club
Where: Hutch & Sons, Evansville IN.
When: 7 PM, the second Wed. of each month.
Info: Send SASE to Bob Heerdink, President, Evansville Computer Club, c/o National Sharedata Corp., PO Box 3895, Evansville IN 47737.

Delaware Lehigh and Lehigh Valley Amateur Radio Clubs
What: Hamfest, Computerfest, Electronics Fair.
Where: Franko's Farm, 1301 Black River Rd., Bethlehem PA.
When: July 20, 1980 from 8 AM to 4 PM.
Info: Wayne Comstock WB3CDL, RD#1, Box 162B, Saylorsburg PA 18353.

Southern Maine TRS-80 Computer Club
Where: Maine Medical Center, Portland ME, in Classroom 2.
When: 6:30 PM, the first Tues. of each month.
Info: Douglas Stewart, (207) 767-2351.

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H8 owners—Centronics P1 printer, H8 interface board, 10 rolls paper and cables. Plug-in & run. Used for 3 rolls paper. Mint cond, $400. Call (412) 335-5639, evenings. P. O'Connor.

IBM model 5028 operator station (Teletype model 33) with UCC 38 call control, $250. J. Grundy, 141 Buckley Ln., Battle Creek MI 49017. (616) 964-8193.

For Sale: Altair 8800A, 16K, Meca Alpha 1, tape, 2SIO, Act 1 terminal, 8K & extended BASIC. $1400 takes all or will separate. D. Gietzen, 313 Meadow Lane, Hastings MI 49058. (616) 945-5334.

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Wanted: SWTP computer with dual floppies. Dr. Gordon, 1435 W. 49th Place, Hialeah FL. (305) 822-1100.

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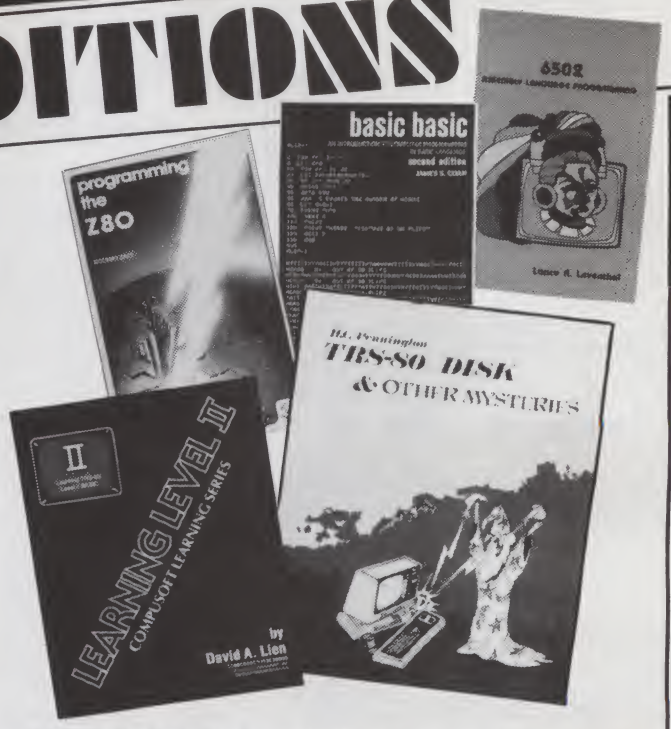
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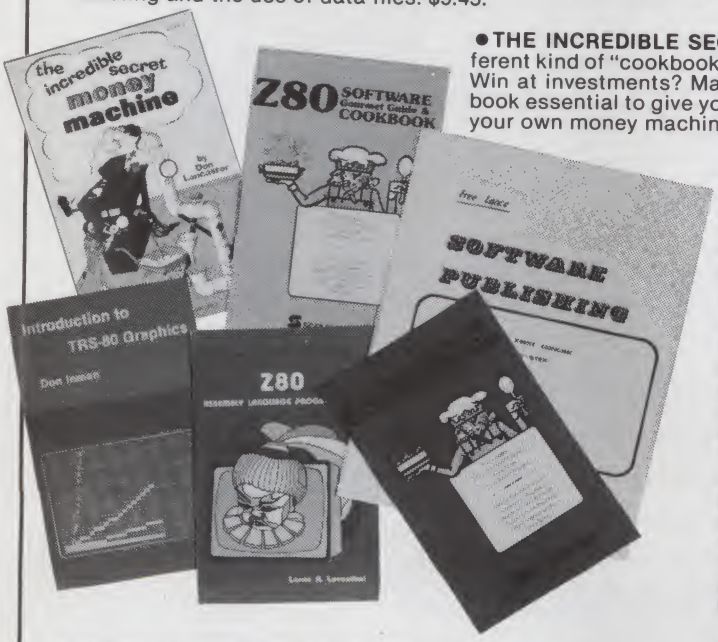
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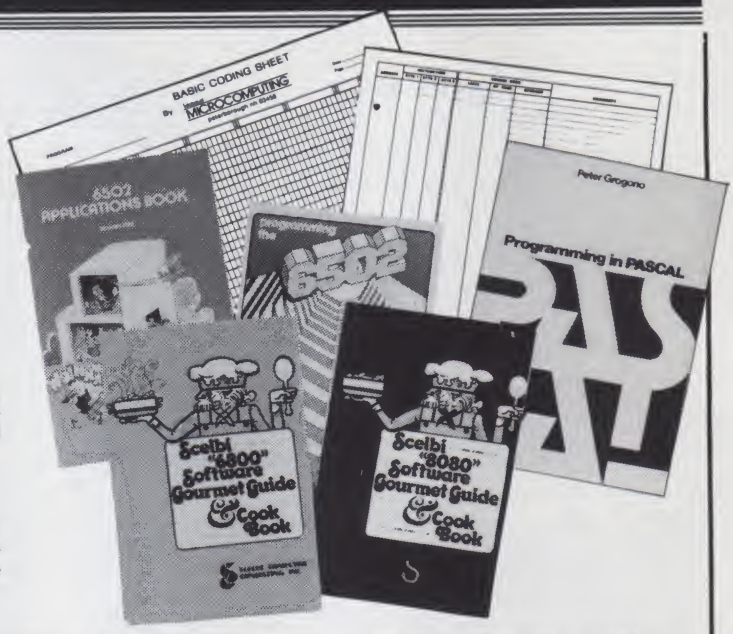
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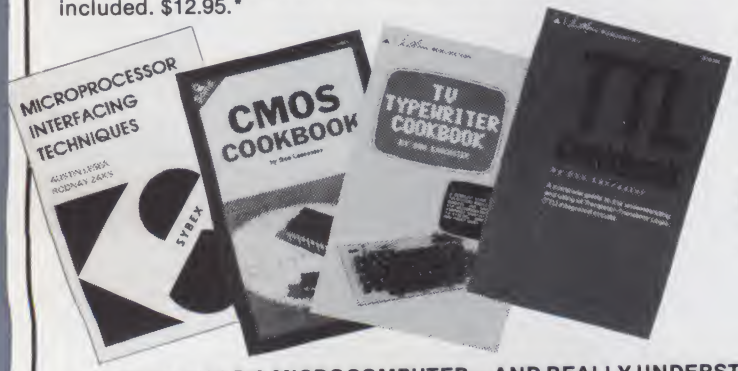
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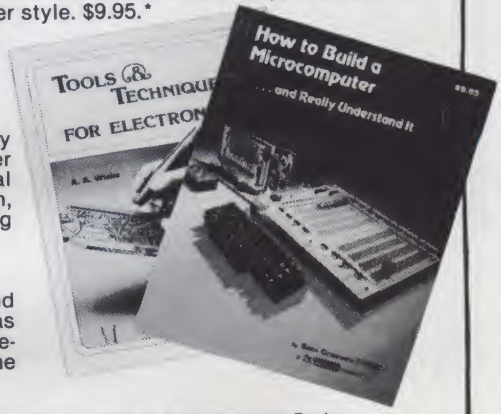
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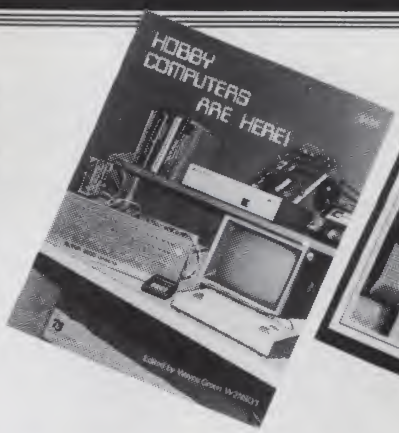
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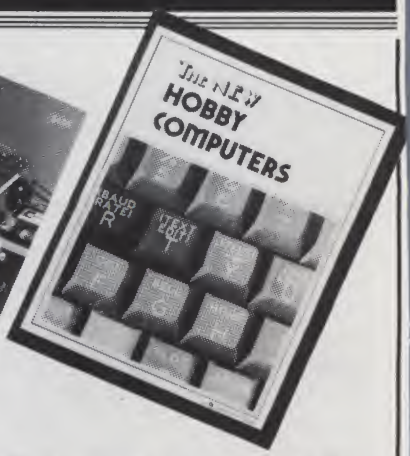
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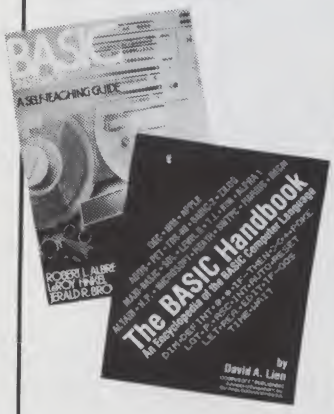
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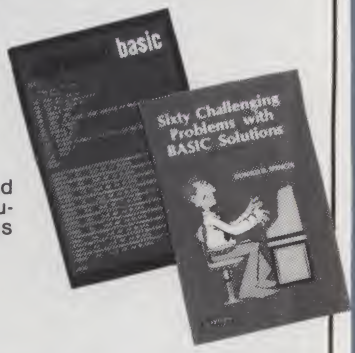
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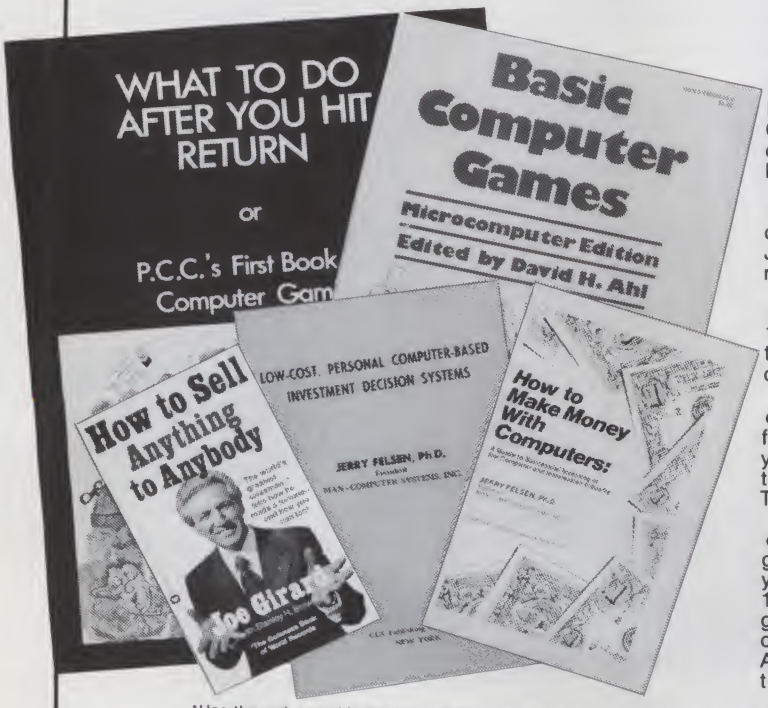
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Take a Computer to School

Computers are either too difficult, too fussy or too delicate for elementary-school students to use. Right? Wrong—as I learned when I took my husband's computer to school for the last two weeks of the school year. I found that the children loved using the computer and took reasonable care of the machine.

Even when schools have computers available for student use, grade-school students seldom get to use them. Highschoolers have priority, junior-high students sometimes use them, but the lowly grade-school student doesn't stand a chance. Only through the kindness of computer hobbyists can a grade-school youngster learn something about computers.

Computers for Young Students

Why should students so young start using computers? Mainly to become familiar with the computer and its keyboard. Many people are reluctant to use a computer for fear of damaging the machine. The fifth graders who used our computer were more at ease with it, and learned more quickly, than the sixth graders. I think this was because they hadn't learned to be afraid of it.

It also gives them a chance to become familiar with different arithmetic bases, even though they haven't studied them in math class. Generally, the kids felt it was silly to have a base-2 system, but they took my word for it that the computer couldn't understand their own base 10. Later, when they study other bases, they will understand the reason for other number bases.

Allowing them to use the computer early may also prevent their ending up like my mother-in-law (a science major no less) who feels that computers are alive, have nasty personalities and are out to get you.

My Application

My husband, David's, and my computer is a Digital Group Z-80 system, built from a kit. At the time it went to school, the computer used Tiny BASIC and had only a 10K memory. A CRT completed the system. As soon as the kits were completed, I began thinking of taking the computer to school for the last weeks of school. May seemed like a good time to give the kids something new to do, and nothing could be newer, or stranger, than a computer at school.

I designed the programs for the fifth and sixth grade levels at the Irving Elementary School. For more grade levels, you would have to develop different instructions for them to use. Working with these 10- to 12-year-olds, I found that they do not follow instructions the same way adults do. You must be very exact in what you tell them and still be prepared for interesting results.

I don't think the students ever realized that they could have had hard copy with a little more effort and equipment. They were delighted watching the CRT screen, although I wish I could have sent home a short program with every one of them. They had no illusions, however, about the computer being complete. When it went to Irving, the cases had yet to arrive. To protect the keyboard, David made a wooden case, ugly but practical. The computer was placed in a window facing the hall, where students could watch it, but not handle it.

I began preparing the students two weeks before the computer arrived. As a librarian, I wanted the students to learn about books as well as computers, so I featured a display of computer books—all two of them. Charts illustrating the main components of a computer were put on the wall. There was a 5 foot poster showing a "Flowchart for Counting Giraffes Met on the Way to School" (taken from Srivastara's book, *Computers*). This chart created much interest. "But that's silly," said one sixth-grade girl. "It wouldn't take all that work just to count giraffes, even if there were any in Waverly." I explained to her that the computer needed to be told each and every step it had to take, but she still had trouble believing it.

One week before the computer arrived, a countdown began in the hall window where the CPU would be placed. Every day another piece of information was placed on the sign and, on the last day, a list of games and drills we would use was added. By that time, students were dropping into the library to ask, "Is it *really* coming?"

Students were free to come to the library to use the computer, and teachers could come after school and play more advanced games. My husband was available the first week to conduct mini-courses on the workings of a computer. Half of the teachers made use of this mini-course.

Games on the computer are fun, but I wanted to show how useful it could be, so I alternated games and drills. The first day there was Number, a number-guessing game, and one of our most popular programs. It was a good introduction to the computer, since there was nothing "wrong" about an incorrect guess—it was just bad luck. The game was limited to numbers between 0 and 100 to control the amount of time each student could use it. They were limited to one game each, unless everyone else in the library had already played.

On Tuesday, students waited in line to tackle addition problems on the computer. Teachers couldn't believe it. Student response was as enthusiastic to the drills as to the number game. On Wednesday, we played Ticktacktoe. In Tiny BASIC, this game is too simple for even the fifth-graders. The computer did not try to block your move. The kids found the game too easy, but were ecstatic when they beat the computer.

Next, I programmed a subtraction drill, virtually identical to the addition drill. Kids still lined up to play. On Friday, the entire fifth grade was gone, so it seemed a good time for Brainteaser, which proved to go over the heads of the students. It also created an enormous amount of frustration, and the use of the computer actually fell off on Friday, even though it was playing a game. Some of the students discovered that they could lose the game, rather than win it, and set to work to lose each time. This convinced me that the next time Brainteaser goes back to school, there will be two ways of winning it—one the way the rules state, and the other the way the kids developed it.



Fifth- and sixth-grade students around Irving's computer TV readout. (Photos by the Waverly Independent-Democrat*)*

On Monday of the second week, we played Bomber, a worthless game, but its comments go over extremely well. Tuesday we had multiplication in the morning and division in the afternoon. Wednesday there was Matador, a much more successful game than Bomber, even though the kids didn't know what the bullfighting terms meant. And on Thursday there was Life. On Friday, at long last, the computer was packed up and taken home.

Rules for Computer-to-School Loan

If you are planning to lend your computer to a school there are certain things you should do. If you follow these rules, the experience will be enjoyable and beneficial to both you and the students.

1. Decide how long the computer will be on loan. From experience, I would say that two weeks is too long. The novelty of the computer's visit tends to wear off much sooner. Once that happens, the students stop following the directions exactly. Anywhere from one day to one week would be adequate, depending on how large the school is. With our 250 students, I would be tempted to leave it at the school for only one week next time, although I'm sure even two days would be sufficient.

2. Find someone to be in charge. This will probably mean teaching someone how to operate it. I know that a couple hours' work on the computer is enough to master the techniques to keep it running. If nothing else worked, I could always reload it. My first choice would be the librarian who would be available during school hours. Perhaps a math or science teacher with a personal interest in the computer would be a good choice. However, this would mean that the computer would be located in a classroom and wouldn't be available at all times. Consider also the principal, or a school secretary, who might be able to arrange his schedule to handle the computer and the eager students.

3. Check with your insurance agent. You probably aren't covered if you take your computer out of your house. And you certainly can't assume that the school is going to cover its cost if it is stolen. My husband checked with our insurance agent and got a floater policy for the computer. For $34 a year, we had peace of mind.

4. Name your computer. You may not personally care what it's called, but the kids will identify with it better if it has a name. Ours is now named Irving, because it had its debut at Irving School. No matter what you name it, the kids will adopt the name. Ours were soon asking me about Irving and what "he" would be doing the next day.

5. Get publicity out to the teachers. The person in charge should do this, but you may have to type a master yourself to get it done. Briefly explain the time the computer can be used, what games or drills will be available, what games the teachers can play after school and your schedule to give mini-explanations about the computer (if you can find the time).

6. If you can teach mini-courses, schedule them for one day. Unless you're used to giving talks, you might as well get it over with in a hurry. Besides, you will find the talk gets better as the day goes on. Make sure you understand what grades you will be meeting, then be sure you make your talk simpler than that level. Most buzzwords are out. Tell the students about the computer (its input, CPU, memory and output). Define all terms they won't know. If you have an inoperative chip, pass it around. Write the teacher's name in binary, octal or hex. No one, including the teacher, will believe that that strange assortment of symbols could possibly spell a name the entire class knows. Program the computer on the spot to do something simple, like add 2 and 3. And above all, let the kids ask questions.

7. If at all possible, stay the first day the computer is at school. That would be a good day for the mini-courses, too. No matter how well you've taught someone else to run your computer, you can't anticipate all of the problems. You'll be surprised how ingenious the students can be in messing up the program, and you're the best person to bail them out. By the second day, however, the person who is going to be in charge of the computer will be better equipped to rescue the students from their mistakes. After all, they watched you do it the day before.

8. Make the program escape-proof. *Don't* let the students have the chance to get back into the operating system, or they will. Loop the end of each game or drill back to the beginning. Comments like "Please tap return so I will be ready for the next person who wants to play" serve the purpose. If you have a computer that can't handle large numbers without wrapping around (and ours couldn't), make sure you add some statement in the program to tell the kids how large a number they can put in.

9. Change the text to suit the age. Many of the games you have are fine for younger students if you simplify their instructions, make the instructions more complete or change words that are too difficult. Matador, for instance, should be edited so that the word "posthumous" is replaced by the phrase "after you are dead." If your computer asks for two numbers separated by a comma, tell the students that they will have to enter a number, a comma and then a second number. Or if they are separated by a question mark, tell students to tap the return key. Notice that I always talk about "tapping" or "pressing" or "pushing" the return key instead of the traditional "hit return." Grade-school students will probably follow that order



Sixth-grade student with Irving's owner, Dave Johnson.

literally and hit it, with either a fist, a book or a notebook. I didn't want to take that chance, so everytime that command arose, I always used a gentler word. Don't bother to change the snide comments resident in so many programs. The kids love them. Even if Bomber wasn't a great game, its comments were the hit of the school.

10. Publicity is something you may, or may not, want. We thought it would be good for the school and approached the principal about it. He was interested, and the local paper was happy to do the article. After all, ours was the first elementary school in the area to have a computer.

11. Be sure to include drills as well as games to show the educational value of computers. You probably hope that the school will see enough merit in the computer to add one to the school's resources. If you're into computers and you're like most converts, you'll be glad to see others coming along with the same interest.

12. Have some convenient means of producing hard copy. Imagine the thrill of the student when he takes home something he did himself on the computer. Even better would be a program to call him by his first name. We didn't have a printer, and the kids didn't suffer; but I hope the next time Irving goes back, we'll be able to give them a printout.

13. Don't bring your computer the last week of school. The kids are too distracted. The week before would have been better. Irving's next visit will probably be during the early winter.

Conclusion

Was it worth the time and trouble? Definitely! The computer at Irving ran continually for at least six hours each day. You haven't met an appreciative audience until you've seen a group of grade-school students crowded around your computer. The kids at Irving were so delighted with it that they took an active interest to make sure everyone had a turn.

Were we glad to get Irving home? Of course. There were so many things we wanted to try, programs we wanted to work on. But is Irving home to stay? Not on your life. David is a minister so he took Irving to Bible school and plans a visit to a Lions Club meeting. David also wants to take the computer to a sixth-grade class in a neighboring town. And I'm already planning Irving's return trip to the elementary school. It's fun being an "expert' in a field, and to the kids you're an expert. It's even more fun watching the enthusiasm kids have when working on a computer.■

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74LS163N	1.65	CD4001	.35	8T13	3.00				
74LS174N	2.00	CD4002	.35	8T20	5.50				
74LS190N	1.25	CD4006	1.10	8T23	3.10				
74LS221N	2.50	CD4007	.35	8T24	3.50				
74LS258N	1.60	CD4008	.28	8T25	3.20				
74LS367N	1.65	CD4009	.45	6T26	1.69				
		CD4010	.45	6T28	2.75				
LINEAR		CD4011	.35	6T97	1.69				
CA3045	.90	CD4012	.28	6T98	1.69				
CA3046	1.10	CD4013	.47						
CA3061	1.80	CD4014	1.25	**MOS/MEMORY RAM**					
CA3082	1.90	CD4015	1.00	2101-1	2.95				
CA3089	2.95	CD4016	.55	2102-1	.95				
LM301AN/AH	.35	CD4017	1.05	2102AL-4	1.20				
LM305H	.87	CD4016	.94	2102AN-2L	1.60				
LM307N	.35	CD4019	.45	21L02-1	1.16				
LM308N	1.00	CD4020	1.15	2104A-4	4.95				
LM309K	1.50	CD4021	1.35	2107B-4	3.75				
LM311H/N	.90	CD4022	1.10	2111-1	3.75				
LM317/K	3.75	CD4023	.28	2112-2	3.95				
LM316	1.35	CD4024	.75	2114L 300ns	7.40				
LM320K-5	1.50	CD4025	.26	2114L 450ns	6.40				

4116 200ns	9.50
8/4116 200ns	60.00
2513B	6.30
MM5262	.40
MM5280	3.00
MM5320	9.95
MM5330	5.94
PD411D-3	4.00
PD411D-4	5.00
P5101L	6.95
4200A	8.95
82525	2.90
91L02A	1.50
HD0165-5	6.95
MM57100	4.50
GIAY38500-1	9.95
MCM66751A	9.95
9368	3.50
410D	10.00
416	16.00

CONNECTORS

30 pin edge	2.50
44 pin edge	2.75
100 pin edge	4.50
100 pin edge WW	5.25

IC SOCKETS

Solder Tin Low Profile			
PIN	1 UP	PIN	1UP
8	.15	22	.30
14	.14	24	.35
16	.16	28	.42
18	.27	36	.58
20	.29	40	.57

2 level 14 pin ww 20

WIRE WRAP LEVEL 3

PIN		PIN	
14	.32	24	.66
16	.33	28	1.00
18	.57	40	1.23

CRYSTALS

1 MHz	4.50
2 MHz	4.50
4 MHz	4.25
5 MHz	4.25
10 MHz	4.25
16 MHz	3.90
20 MHz	3.90
32 MHz	3.90
32768 Hz	4.00
1.8432 MHz	4.50
3.5795 MHz	1.20
2.0100 MHz	1.95
2.097152 MHz	4.50
2.4578 MHz	4.50
3.2768 MHz	4.50
5.0688 MHz	4.50
5.185 MHz	4.50
5.7143 MHz	4.50
8.5536 MHz	4.50
14.31818 MHz	4.25
18.432 MHz	4.50
22.1184 MHz	4.50

KEYBOARD ENCODERS

AY5-2376	$12.50
AY5-3600	17.95
AY5-9100	10.50
AY5-9200	18.50
74C922	5.50
74C923	5.50
HD0165-5	8.95
AY5-9400	10.50

D Connectors RS232

DB25P	2.95
DB25S	3.95
Cover	1.50
DE9S	1.95
DA15P	2.10
DA15S	3.10

Hickok 3½ Digit LED multimeter $9.95
Stopwatch Kit 26.95
Auto Clock Kit 17.95
Digitel Clock Kit 14.95

8K/16K Eprom Kit (less PROMS) $89.00
Motherboard $39.00
Extender Board $8.99

RESISTORS ¼ watt 5%
10 per type .03
25 per type .025
100 per type .015
1000 per type .012
350 piece pack
5 per type 6.75
½ watt 5% per type .05

Televideo Terminal 912 $845.00

KEYBOARDS

56 key ASCII keyboard kit	$67.50
Fully assembled	77.50
53 key ASCII keyboard kit	60.00
Fully assembled	70.00
Enclosure Plastic	14.95
Metal Enclosure	29.95

LEDS

Red T01¾	.15
Green, Yellow T01¾	.20
Jumbo Red	.20
Green, Orange, Yellow Jumbo	.25
Cliplite LED Mounting Clips 8/$1.25 (specify red, amber, green, yellow, clear)	

CONTINENTAL SPECIALTIES in stock
Complete line of breadboard test equip.
MAX-100 8 digit Freq. Ctr. $128.95
DK WIRE WRAP TOOLS in stock
Portable Multimeter $18.00

Complete line of AP Products in stock.

SPECIAL PRODUCTS

MM5865 Stopwatch Timer with 10 pg. spec	9.00
PC board	7.50
Switches Mom Pushbutton	.27
3 pos. slide	.25
Encoder HD0165-5	6.95
Paratronics 100A Logic Analyzer Kit	$224.00
Model 10 Trigger Expander Kit	$229.00
Model 150 Bus Grabber Kit	$369.00
Sinclair 3½ Digit Multimeter	$59.95
Clock Colander Kit	$23.95
2.5 MHz Frequency Counter Kit	$37.50
30 MHz Frequency Counter Kit	$47.75

TRANSFORMERS

8V 300 ma	3.25
12 Volt 300 ma transformer	1.25
12 8V CT 600 ma	3.75
12V 250 ma wall plug	2.95
12V CT 250 ma wall plug	3.50
24V CT 400 ma	3.95
10V 1.2 amp wall plug	4.65
12V 6 amp	12.95
12V 500 ma wall plug	4.75
12V 1 amp wall plug	8.50
12V 3 amp	6.50
10/15 VAC 8/16 VA wall plug	9.75

DISPLAY LEDS

MAN1	CA	.270	2.90
MAN3	CC	.125	.39
MAN72/74	CA/CA	.300	1.00
DL704	CC	.300	1.25
DL707/DL707R	CA	.300	1.00
DL727/728	CA/CC	.500	1.90
DL747/750	CA/CC	.600	1.95
DL750	CC	.600	1.95
FND359	CC	.357	.70
FND500/507	CC/CA	.500	1.35
FND503/510	CC/CA	.500	.90
FND800/807	CC/CA	.800	2.20
3 digit Bubble			60
4 digit Bubble			80
DG8 Fluorescent			1.75
DG10 Fluorescent			1.75
5 digit 14 pin display			1.00
10 digit display			1.25
7520 Clairex photocells			39
TIL311 Hex			9.50
MAN3640	CC	30	1.10
MAN4610	CA	40	1.20
MAN4640	CC	40	1.20
MAN4710	CA	40	.95
MAN4740	CC	40	1.20
MAN6640	CC	.58	2.95
MAN6710	CA	60	1.35
MAN6740	CC	60	1.35
MA1002A			**8.95**
MA1002E			**8.95**
MA1012A			**8.95**
102P3 transformer			**2.25**
MA1012A Transformer			**2.25**

Rockwell AIM 65 Computer

6502 based single board with full ASCII keyboard and 20 column thermal printer. 20 char. alphanumeric display, ROM monitor, fully expandable. **$375.00.** 4K version **$450.00.** 4K Assembler **$85.00,** 8K Basic Interpreter **$100.00.**

Special small power supply for AIM65 assem. in frame **$49.00.** Complete AIM65 in thin briefcase with power supply **$485.00.** Molded plastic enclosure to fit AIM65 plus power supply **$47.50.** Special Package Price: 4K AIM, 8K Basic, power supply, cabinet **$599.00**

AIM65/KIM/VIM/Super Elf 44 pin expansion board; 3 female and 1 male bus. Board plus 3 connectors **$22.95.**

AIM65/KIM/VIM I/O Expansion Kit; 4 parallel and 2 serial ports plus 2 internal timers **$39.00.** PROM programmer for 2716 **$150.00.** 32K RAM Board assem. **$419.00.** 16K RAM assem. **$360.00**

Multi-volt Computer Power Supply

8v 5 amp, ±18v .5 amp, 5v 1.5 amp, −5v .5 amp, 12v .5 amp, −12 option. ±5v, ±12v are regulated. Kit $29.95. Kit with punched frame $37.45, $4.00 shipping. Kit of hardware $14.00. Woodgrain case $10.00, $1.50 shipping.

PROM Eraser

Will erase 25 PROMs in 15 minutes. Ultraviolet, assembled **$37.50**
Safety switch/Timer version **$69.50**

60 Hz Crystal Time Base Kit $4.40

Converts digital clocks from AC line frequency to crystal time base. Outstanding accuracy.

NiCad Battery Fixer/Charger Kit

Opens shorted cells that won't hold a charge and then charges them up, all in one kit w/full parts and instructions. **$7.25**

LRC 7000+Printer $389.00

40/64 column dot matrix impact, std. paper. Interface all personal computers.

S-100 Computer Boards

8K Static RAM Kit	$129.00
8K Static Godbout Econo IIA Kit	145.00
16K Static Godbout Econo XIV Kit	$285.00
24K Static Godbout Econo VIIA-24 Kit	435.00
32K Static Godbout Econo X-32 Kit	$575.00
16K Dynamic RAM Kit	199.00
32K Dynamic RAM Kit	310.00
64K Dynamic RAM Kit	470.00
Video Interface Kit	**$129.00**

80 IC Update Master Manual $55.00

Complete IC data selector, 2700 pg. master reference guide. Over 51,000 cross references. Free update service through 1980. Domestic postage $3.50. 79IC *Master closeout $29.95.*

Z80 Microcomputer

16 bit I/O, 2 MHz clock, 2K RAM, ROM Breadboard space. Excellent for control. Base Board $28.50. Full Kit $99.00. Monitor $20.00. Power Supply Kit $35.00.

Video Modulator Kit $8.95

Convert TV set into a high quality monitor w/o affecting usage. Comp. kit w/full instruc.

Modem Kit $60.00

State of the art, orig., answer. No tuning necessary. 103 compatible 300 baud. Inexpensive acoustic coupler plans included.

BSR Controller $39.95

Connect your computer to the BSR Home Control System. Computer controlled ultrasonic transmitter for your BSR. Software for 1802 user.

TERMS: $5.00 min. order U.S. Funds. Calif residents add 6% tax.
BankAmericard and Master Charge accepted.
Shipping charges will be added on charge cards.

FREE: Send for your copy of our NEW 1980 QUEST CATALOG. Include 28¢ stamp.

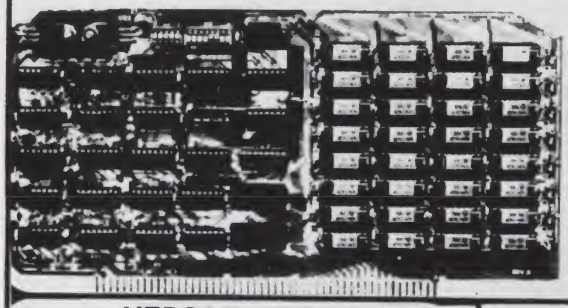
SD SYSTEMS

FACTORY REBATE SALE

WOW

When you purchase any S.D. SYSTEMS Computer Board, either kit or A&T from PRIORITY 1 ELECTRONICS you will receive a COUPON FOR A $25.00 CASH REBATE Direct from the Manufacturer SD SYSTEMS. Combine the Rebate with our already low prices, and you can hardly afford to pass up this special offer.

SD EXPANDORAM *The Ultimate S-100 Memory*



EXPANDO 64 KIT (4116)

	List Price	Sale Price
16K	385.00	189.00
32K	550.00	244.00
48K	715.00	298.00
64K	880.00	349.00

The EXPANDORAM is available in versions from 16K up to 64K, so for a minimum investment you can have a memory system that will grow with your needs. This is a dynamic memory with the invisable on-board refresh, and IT WORKS!

- Interfaces with Altair, IMSAI, SOL-8, Cromenco, SBC-100, and others.
- Bank Selectable
- Phantom
- Power 8VDC, ± 16VDC, 5 Watts
- Lowest Cost Per Bit
- Uses Popular 4116 RAMS
- PC Board is doubled solder masked and has silk-screen parts layout.
- Extensive documentation clearly written
- Complete Kit includes all Sockets for 64K
- Memory access time: 375ns, Cycle time: 500ns.
- No wait states required.
- 16K boundries and Protection via Dip Switches
- Designed to work with Z-80, 8080, 8050 CPU's

VERSAFLOPPY II

DOUBLE DENSITY, DOUBLE SIDED, DISC CONTROLLER

GENERAL DESCRIPTION
Versafloppy II is a flexible disk drive controller that incorporates a wide range of capabilities into one board. It operates with double density soft sectored format which provides 985,600 bytes of storage on a double sided 8 inch diskette and 129,920 bytes per side on a five inch mini-diskette. The Versafloppy II directly controls many popular disk drives. These include Shugart SA400 and SA450, Shugart SA800 and SA850, Mayflower MFE500 and MFE700, Persci 70 and 277, and Siemans, BSI-105.

NEW

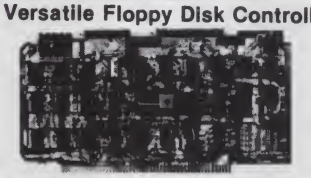


- S-100 Bus IEEE Standard Compatible
- IBM 3740 Compatible Soft Sectored Format for Single Density Drives
- Operates with both Standard (8") and Mini (5") Drives Simultaneously
- Provides Control for Double Sided Operation
- Operates with Z80, 8080, and 8085 Central Processing Unit
- Controls up to four drives
- Vectored Interrupt Operation Optional
- Control and Diagnostic Software Available in PROM
- SDOS Disk Operating System Compatible

SDS-VERSAFLOPPY II KIT.....$335.00
SDS-VERSAFLOPPY II KIT.....$425.00

DISC CONTROLLER

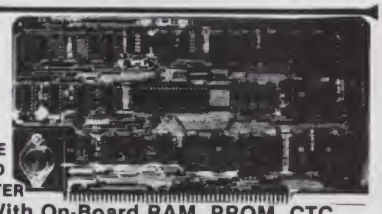
SD "VERSAFLOPPY" KIT
The Versatile Floppy Disk Controller



FEATURES IBM 3740 Soft Sectored Compatible S-100 Bus Compatible for Z-80 or 8080 Controls up to 4 Drives (single or double sided) Directly controls the following drives:
1. Shugart SA400/450 Mini Floppy
2. Shugart SA800/850 Standard Floppy
3. PERSCI 70 and 277
4. MFE 700/750
5. CDC 9404/9406
6. GSI-Siemens FDD120-8
34 Pin Connector for Mini Floppy 50 Pin Connector for Standard Floppy Operates with modified CP/M operating system and C Basic Computer. The new Versafloppy from S.D. Computer Products provides complete control for many of the available Floppy Disk Drives. Both Mini and Full Size. FD17718 Single Density Controller Chip. Listings for Control Software are included in price. CP/M for SD VersaFloppy $100.00

DISC CONTROLLER
SD "VERSAFLOPPY" KIT
The Versatile Floppy Disk

$235.00



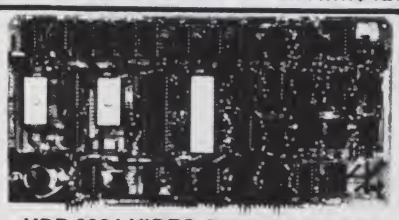
SINGLE BOARD COMPUTER

With On-Board RAM, PROM, CTC

- S-100 Bus Compatible
- Z80 Central Processing Unit
- 1024 Bytes of Random Access Memory
- 8K Bytes of PROM using 2716
- Parallel Input and Output Ports
- Four Channel Counter/Timer (Z80-CTC)
- Software Programmable Baud Rate Generator
- No Front Panel Required for Operation

Sale Price

SDS-SBC-100 2MHZ KIT.....$280.00
SDS-SBC-100 2MHZ A&T.....$350.00
SDS-SBC-200 4MHZ KIT.....$299.00
SDS-SBC-200 4MHZ A&T.....$369.00



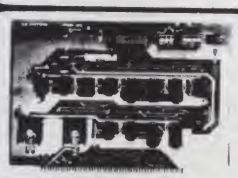
VDB-8024 VIDEO DISPLAY BOARD

With on-board Z80 Microprocessor

- S-100 bus Compatible
- Full 80 Characters by 24 Lines Display
- Characters Displayed by High Resolution 7 x 10 Matrix
- Composite or TTL Video Output
- Keyboard Power and Interface
- Forward and Reverse Scrolling Capability
- Blinking, Underlining, Field Reverse, Field Protect and Combinations
- Full Cursor Control
- 96 Upper and Lower Case Characters
- *32 Special Character Set*
- 128 Additional User Programmable Characters (Optional)
- On-Board Z80 Microprocessor
- 2K Bytes Independent On-Board RAM Memory
- Glitch-Free Display

Sale Price

SDS-VDB-8024 KIT.....$335.00
SDS-VDB-8024 A&T.....$469.00



PROM-100

Programming Board for PROM Development

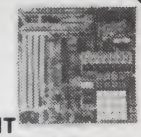
NEW

SD SYSTEMS' PROM-100 is a versatile PROM programming board offering complete EPROM programming capability. The board operates on the industry standard S-100 Bus. Support software verifies the erasure of EPROM and verifies the loaded program. SD SYSTEMS' PROM-100 offers a support-software listing with its operations manual.

- S-100 Bus Compatible
- Programs the Following EPROM s: 2708, Intel 2758, 2716, 2732 and Texas Instruments 2516
- Dip Switch Selection of EPROM type
- 25 VDC Programming Pulse Generated On Board
- Maximum Programming time: 16,384 Bits In 100 Seconds
- Power Requirement: +8VDC at 300 ma.; +16 VDC atr 100 ma.; −16 VDC at 60 ma.
- TTL compatible
- Software Provides for Reading of Object File from SDOS, CP/M or PROM and Programming into EPROM
- Program Verification • Verification of Erasure
- Zero Insertion Force Socket

Sale Price

SDS-PROM-100 KIT..... $175.00
SDS-PROM-100 A&T..... $225.00



Z80 STARTER KIT

A Complete Microcomputer On A Board

- Z80 CPU with 158 instructions
- On-Board Keyboard and Display
- On-Board PROM Programmer for Single Voltage PROMS (2716, 2758, TI2516)
- Kansas City Standard Cassette Interface
- Simple Key Controlled Audio Cassette Load and Dump
- Expansion Provision for Mounting Two S-100 Connectors (Sockets Not Included)
- Wire Wrap Area for Custom Circuitry
- Single Step through RAM or PROM
- Memory Examine and Change
- Port Examine and Change
- Z80 CPU Register and Change
- 2K Byte ZBUG Monitor In ROM
- 1K Bytes of RAM (Expandable to 2K Bytes)
- A 4 Channel Hardware Counter/Timer (Z80-CTC)
- Two Bi-Directional 8-Bit I/O Ports (Z80-P10)
- Up to 5 Programmable Breakpoints
- Switch Selectable PROM or Monitor Restart
- Vectored Interrupts provided by Z80-CTC and

Sale Price

SDS-Z80 STARTER KIT.....$299.00
SDS-Z80 STARTER A&T.....$439.00

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1-800-423-5633
except CA., AK., HI., CALL
(213) 894-8171

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master charge

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*SOCKET and CONNECTOR prices based on GOLD, not exceeding $500 per oz.

*Sale Prices are for prepaid orders only credit card orders will be charged appropriate freight

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PRIORITY ONE ELECTRONICS

CENTRONICS 730 Dot Matrix Printer

SAVE $100.00



WOW

PRICE $695.00

WOW

STANDARD FEATURES: • 50 Characters/second • Characters/line • 10 characters/inch • 3-way paper handling system • 7 x 7 dot matrix • 96 character ASCII • microprocessor electronics • unidirection print at 5.0 ips • high speed return approximately 10 ips • 21 lpm with 80 columns printed • 58 lpm with 20 columns printed • 80 character buffer • 6 lpi vertical • Centronics Colors and logo

FORMS HANDLING: Roll Paper 8.5 in. x 5.0 dia. with 1 in. core maximum dimension 3.5 in. wide with .38 in. core minimum dimension. Fan Gold: 9.0 in. /22.9 cm. wide pin to pin 9.5 in./24.1cm wide overall. Up to 3 ply paper with 2 carbons (total thickness not to exceed .012 inches) Cut Sheet: Maximum width 8.5 inches

RIBBON SYSTEM: Continuous ribbon 9/16" (14mm) wide, 20 yards (18.3 meters) long Mobius Loop allows printing on upper and lower portion on alternate passes

OPERATOR CONTROLS: Power on/off. Reset Switch allows disabling of printer without dropping AC

DATA INPUT: 7 or 8 bit ASCII parallel, TTL levels with strobe. Acknowledge pulse indicates that data was received

PHYSICAL DIMENSIONS: Weight: less than 10 lbs./5 kg. Width: 14.5 inches/37 cm. Depth: 11.0 inches/28cm. Height: 4.89 inches/13cm. Dimensions exclusive of roll paper holder.

SHIPPING WEIGHT: 14 lbs.

CEN-730-1 (Parallel Int.)..... LIST PRICE: $795.00

TRS-80/APPLE MEMORY EXPANSION KITS

4116's RAMS

from Leading Manufacturers

(16Kx1 200/250ns)

100% GUARANTEED

1,000's SETS SOLD

8 for $55.00

ADD $3.00 FOR PROGRAMMING JUMPERS FOR TRS-80 KEYBOARD

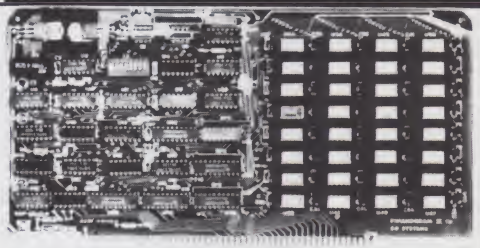
4116's 100 pcs & UP $5.50 each

1000 pcs & UP $5.00 each

4 MHZ EXPANDORAM II KIT

The S-100 Memory Board for the 80's

NEW



SD SYSTEMS' ExpandoRAM II is a state-of-the-art dynamic RAM board with capacities from 16K bytes (4116) to 256K bytes (4164). It operates on the industry S-100 Bus. The ExpandoRAM II's design allows eight boards to operate from the same S-100 Bus. Page mode operation provides the system with the capability of servicing multiple users without RAM interference. Invisible refresh and synchronization with wait states provide greater reliability, and processing speeds up to 4 Mhz.

The ExpandoRAM II is compatible with some S-100 CPU's based on the Z80 microprocessor. When other SD SYSTEMS 200 series boards are combined with the ExpandoRAM II, they create a microcomputer with exceptional capabilities and features.

- S-100 Bus Compatible
- Up to 4Mhz Operation
- Expandable Memory from 16K to 256K
- DIP Switch Selectable Boundaries
- Uses 16K (4115) or 64K (4164) Memory Devices
- Page Mode Operation Allows up to 8 Memory Boards on Bus
- Operates with Z80 CPU's
- Phantom Output Disable
- Invisible Refresh (Synchronized with Wait States)

SDS - EXPANDOPRAM II KIT (4116)

Sale Price

16K . . . $280.00 48K . . $399.00

32K . . . $340.00 64K . . $459.00

LOBO 8" DISK DRIVE CABINET



New from Lobo, a dual Cabinet with power supply, and internal data cable hook-up.

- Cabinet accepts 2 801R, 800R, FD120, or FD200 style disk drives.
- Power Supply for 2 drives.
- Assembled, tested and guaranteed by Lobo Drives.
- Shipping Weight 30 lbs.

LBO — DUAL 8 PCS.....$329.00

BUY CABINET AND DRIVES AND $AVE

WITH 1 DRIVE	WITH 2 DRIVES
LBO-801R-1PSC $775.00	LBO-801R-2PSC $1250.00

DISC DRIVE ONLY

SHU-801R.....$499.00

EXTERNAL DATA CABLES

CARDEDGE TO CARDEDGE	CARDEDGE TO SOCKET
PRI-50CE-CE $19.95	PRI-50CE-SKT $19.95

NEW MS-230 DUAL TRACE MINISCOPE 30 MHz BANDWIDTH



1 NLS MS-230 30 MHZ Scope . . . $598.15

2 NLS 41-141 10 to 1 Combo Probe $54.00

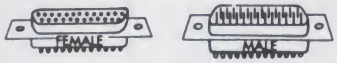
1 NLS 41-180 Deluxe Leather Case $45.00

LIST PRICE..... $697.15

MS 230 COMBO PRICE..... $547.15

SAVE $150.00

RS232 and "D" SUB-MINIATURE CONNECTORS



P = Plug, Male Type - S = Socket, Female Type - C = Cover, Hood

PART NO.	DESCRIPTION	PRICE 1-9	10-24	25-99
CND-DE9P	9 Pin Male	1.70	1.50	1.40
CND-DE9S	9 Pin Female	2.35	2.10	2.00
CND-DE9C	9 Pin Cover	1.50	1.35	1.20
CND-DA15P	15 Pin Male	2.45	2.25	2.10
CND-DA15S	15 Pin Female	3.35	3.20	3.00
CND-DA15C	15 Pin Cover	1.60	1.45	1.30
CND-DB25P	25 Pin Male	2.90	2.70	2.50
CND-DB25S	25 Pin Female	3.75	3.65	3.35
CND-DB51212-1	1 pc Grey Hood	1.50	1.30	1.10
DB-P258C	2 pc Grey Hood	1.45	1.25	1.00
DB1226-1A	2 pc Black Hood	1.90	1.65	1.45
CND-DC37P	37 Pin Male	4.40	4.20	3.90
CND-DC37S	37 Pin Female	6.20	5.95	5.70
CND-DC37C	37 Pin Cover	2.25	2.00	1.75
CND-DD50P	50 Pin Male	5.75	5.45	5.00
CND-DD50S	50 Pin Female	9.65	8.85	8.25
CND-DD50C	50 Pin Cover	2.40	2.20	2.00
D20418-S	Hardware Set 2 pr.	1.00	.80	.70
CND-RS232-8FT	RS232, DB25P, EIA class 1 cable 8 con, 8 ft. long	18.00	16.00	14.00
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VRB-MD 525-16	Hard 16 Sector	Micropolis	$ 8.95	$29.95
VRB-FD32 1000	Hard Sector	Shugart 801R	$11.95	$37.00
VRB-FD34 1000	Soft Sector	IBM 3740	$11.95	$37.00

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SN7411N	.25	SN7490N	.45	SN74174N	1.00
SN7412N	.25	SN7491N	.59	SN74175N	1.00
SN7413N	.40	SN7492N	.43	SN74176N	.79
SN7414N	.70	SN7493N	.43	SN74177N	.79
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SN7429N	.39	SN74122N	.39	SN74191N	1.25
SN7430N	.20	SN74123N	.59	SN74192N	.79
SN7432N	.25	SN74125N	.49	SN74193N	.79
SN7437N	.25	SN74126N	.49	SN74194N	.89
SN7438N	.40	SN74132N	.75	SN74195N	.69
SN7439N	.25	SN74136N	.75	SN74196N	.89
SN7440N	.20	SN74141N	.79	SN74197N	.89
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SN7450N	.20	SN74152N	.59	SN74365N	.69
SN7451N	.20	SN74153N	.59	SN74366N	.69
SN7453N	.20	SN74154N	1.50	SN74367N	.69
SN7454N	.20	SN74155N	.79	SN74368N	.69
SN7459A	.25	SN74156N	.79	SN74390N	1.95
SN7460N	.20	SN74157N	.65	SN74393N	1.95

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CD4002	.39	CD4028	.89	CD4072	.49
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CD4009	.49	CD4035	.99	CD4082	.39
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CD4012	.25	CD4042	.99	MC14409	14.95
CD4013	.49	CD4043	.89	MC14410	14.95
CD4014	1.39	CD4044	.89	MC14411	14.95
CD4015	1.19	CD4046	1.79	MC14419	4.95
CD4016	.59	CD4047	2.50	MC14433	13.95
CD4017	1.19	CD4048	1.35	MC14506	.75
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CD4019	.49	CD4050	.69	MC14562	11.95
CD4020	1.19	CD4051	1.19	MC14583	2.49
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CD4023	.29	CD4059	9.95	CD4511	1.29
CD4024	.79	CD4060	1.49	CD4515	2.95
CD4025	.23	CD4066	.79	CD4518	1.29
CD4026	2.95	CD4068	.39	CD4520	1.29
CD4027	.69	CD4069	.45	CD4566	2.25

74C00

74C00	.39			74C163	2.49
74C02	.39			74C164	2.49
74C04	.45	74C85	2.49	74C173	2.60
74C08	.49	74C90	1.95	74C192	2.49
74C10	.39	74C93	1.95	74C193	2.49
74C14	1.95	74C95	1.95	74C195	2.49
74C20	.39	74C107	1.25	74C922	7.95
74C30	.39	74C151	2.90	74C923	6.25
74C42	1.95	74C154	3.00	74C925	8.95
74C48	2.49	74C157	2.15	74C926	8.95
74C73	.89	74C160	2.49	80C95	1.50
74C74	.89	74C161	2.49	80C97	1.50

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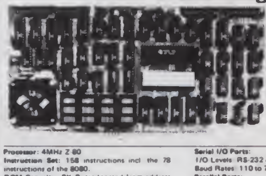
78MG	1.75			LM710N	.79
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LM300H	.80			LM723N/H	.55
LM301CN/H	.35	LM340K-18	1.35	LM733N	1.00
LM302H	.75	LM340K-24	1.35	LM739N	1.19
LM304H	1.00	LM340T-5	1.25	LM741CN/H	.35
LM305H	.60	LM340T-6	1.25	LM741-14N	.39
LM307CN/H	.35	LM340T-8	1.25	LM747N/H	.79
LM308CN/H	1.00	LM340T-12	1.25	LM748N/H	.39
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LM309K	1.25	LM340T-18	1.25	LM1458CN/H	.59
LM310CN	1.95	LM340T-24	1.25	MC1488N	1.95
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LM312H	1.95	LM370N	1.95	LM1496N	.95
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LM320K-5	1.35	LM380CN	.99	LM2901N	2.95
LM320K-5.2	1.35	LM381N	1.79	LM3053N	1.50
LM320K-12	1.25	LM382N	1.79	LM3065N	1.49
LM320K-15	1.35	NE501N	8.00	LM3900N(3401)	.59
LM320K-18	1.35	NE510A	6.00	LM3905N	1.49
LM320K-24	1.35	NE529A	4.95	LM3909N	1.25
LM320T-5	1.25	NE531H/V	3.95	MC5558V	.59
LM320T-5.2	1.25	NE536T	6.00	8038B	4.95
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LM320T-12	1.25	NE544N	4.95	75451CN	.39
LM320T-15	1.25	NE550N	1.30	75452CN	.39
LM320T-18	1.25	NE555V	.39	75453CN	.39
LM320T-24	1.25	NE556N	.99	75454CN	.39
LM323K-5	5.95	NE560B	5.00	75491CN	.79
LM324N	1.49	NE562B	5.00	75492CN	.89
LM339N	.99	NE565N/H	1.25	75493N	.89
LM340K-5	1.35	NE566CN	1.75	75494CN	.89
LM340K-6	1.35	NE567V/H	.99	RC4136	1.25
LM340K-8	1.35	NE570N	4.95	RC4151	3.95
LM340K-12	1.35	LM703CN/H	.69	RC4194	4.95
LM340K-15	1.35	LM709N/H	.29	RC4195	4.49

74LS00TTL

74LS00	.35			74LS139	1.05
74LS01	.35	74LS51	.29	74LS151	1.05
74LS02	.35	74LS54	.29	74LS155	1.05
74LS03	.35	74LS55	.29	74LS157	1.05
74LS04	.42	74LS73	.54	74LS160	1.15
74LS05	.42	74LS74	.54	74LS161	1.39
74LS08	.35	74LS75	.71	74LS162	1.25
74LS09	.42	74LS76	.54	74LS163	1.39
74LS10	.35	74LS78	.49	74LS164	1.50
74LS11	.75	74LS83	1.05	74LS175	1.25
74LS13	.59	74LS85	1.50	74LS181	2.49
74LS14	1.25	74LS86	.54	74LS190	1.39
74LS15	.35	74LS90	.71	74LS191	1.39
74LS20	.35	74LS92	.90	74LS192	1.39
74LS21	.35	74LS93	.90	74LS193	1.39
74LS22	.35	74LS95	.99	74LS194	1.39
74LS26	.35	74LS96	1.15	74LS195	1.39
74LS27	.35	74LS107	.54	74LS253	1.25
74LS28	.35	74LS109	.54	74LS257	1.05
74LS30	.35	74LS112	.54	74LS258	1.75
74LS32	.42	74LS123	1.50	74LS260	.83
74LS37	.45	74LS125	1.05	74LS279	.90
74LS40	.35	74LS132	.99	74LS367	.75
74LS42	1.05	74LS136	.59	74LS368	.75
74LS47	1.05	74LS138	1.05	74LS670	2.49

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Z80-4MHz Single Card Computer



Cromemco's Single Card Computer is a complete computer which brings the power of the Z-80 and the flexibility of the S-100 bus to the dedicated computer environment.

The card offers 4 MHz operation, 8K bytes of on-board 2718 PROM, and 1K byte of static RAM memory. This stand-alone card also provides an RS-232 (or 20mA current loop) serial interface with programmable baud rates to 76,800, vectored interrupts, 24 bits of bidirectional parallel I/O, and 5 programmable timers. Only a power supply and PROM software are required for operation. The Single Card Computer is assembled and tested (Model SCC-W) for $450. The Monitor and Control BASIC are available in two ROM's (Model MCB-216) for $90.

SCC-W (Assembled) **$450.00**

Processor: 4MHz Z-80
Instruction Set: 158 instructions incl. the 78 instructions of the 8080.
ROM Capacity: 8K Bytes located from address 0000 to 1FFF
ROM Type: Intel 2718 PROM or equivalent
RAM Capacity: 1K Bytes located from address 2000 to 23FF
RAM Type: 4045, Static

Serial I/O Ports:
I/O Levels: RS-232 or 20mA current loop
Baud Rates: 110 to 76,800 (software selectable)
Parallel Ports:
Input Port: 24 bits bidirectional
Output Port: 24 bits bidirectional
Input Load: One TTL equivalent
Output Drive: 20 TTL loads
Interval Timers:
Number of timers: 5

Timer range: 0-18.32 milliseconds (software sel.)
Timer resolution: 64 microseconds
Vectored Interrupts:
No. of restart locations (Z-80 mode): 65,536
General Information:
UART type: 5501 Bus: S-100
Power requirements: +8V at 1.4A; +18V at 70mA; −18V at 25mA
Operating environment: 0-55°C

DISCRETE LEDS

XC556R	.200"	red	5/$1	MV50	.085"	red	6/$1	XC111R	.190"	red	5/$1
XC556G	.200"	green	4/$1	XC209R	.125"	red	5/$1	XC111G	.190"	green	4/$1
XC556Y	.200"	yellow	4/$1	XC209G	.125"	green	4/$1	XC111Y	.190"	yellow	4/$1
XC556C	.200"	clear	4/$1	XC209Y	.125"	yellow	4/$1	XC111C	.190"	clear	4/$1
XC22R	.200"	red	5/$1	XC526R	.185"	red	5/$1				
XC22G	.200"	green	4/$1	XC526G	.185"	green	4/$1				
XC22Y	.200"	yellow	4/$1	XC526Y	.185"	yellow	4/$1				
MV10B	.170"	red	4/$1	XC526C	.185"	clear	4/$1				

INFRA-RED LED
¼"x¼"x1/16" flat 5/$1

DISPLAY LEDS

TYPE	POLARITY	HT	PRICE	TYPE	POLARITY	HT	PRICE
MAN 1	Common Anode-red	.270	2.95	MAN 6730	Common Anode-red ± 1	.560	.99
MAN 2	5 x 7 Dot Matrix-red	.300	4.95	MAN 6740	Common Cathode-red-D.D.	.560	.99
MAN 3	Common Cathode-red	.125	.25	MAN 6750	Common Cathode-red ± 1	.560	.99
MAN 4	Common Cathode-red	.187	1.95	MAN 6760	Common Anode-red	.560	.99
MAN 7G	Common Anode-green	.300	1.25	MAN 6780	Common Cathode-red	.560	.99
MAN 7Y	Common Anode-yellow	.300	.99	DL701	Common Anode-red ± 1	.300	.99
MAN 72	Common Anode-red	.300	.75	DL704	Common Cathode-red	.300	.99
MAN 74	Common Cathode-red	.300	1.25	DL707	Common Anode-red	.300	.99
MAN 82	Common Anode-yellow	.300	.49	DL728	Common Cathode-red	.500	1.49
MAN 84	Common Cathode-yellow	.300	.99	DL741	Common Anode-red	.600	1.25
MAN 3620	Common Anode-orange	.300	.49	DL746	Common Anode-red ± 1	.630	1.49
MAN 3630	Common Anode-orange ± 1	.300	.99	DL747	Common Anode-red	.600	1.49
MAN 3640	Common Cathode-orange	.300	.99	DL749	Common Cathode-red ± 1	.630	1.49
MAN 4610	Common Anode-orange	.300	.99	DL750	Common Cathode-red	.600	1.49
MAN 4640	Common Cathode-orange	.400	.99	DL338	Common Cathode-red	.110	.35
MAN 4710	Common Anode-red	.400	.99	FND70	Common Cathode	.250	.69
MAN 4730	Common Anode-red ± 1	.400	.99	FND358	Common Cathode ± 1	.357	.99
MAN 4740	Common Cathode-red	.400	.99	FND359	Common Cathode	.357	.75
MAN 4810	Common Anode-yellow	.400	.99	FND503	Common Cathode(FND500)	.500	.99
MAN 4840	Common Cathode-yellow	.400	.99	FND507	Common Anode (FND510)	.500	.99
MAN 6610	Common Anode-orange-D.D.	.560	.99	5082-7730	Common Anode-red	.300	.99
MAN 6630	Common Anode-orange ± 1	.560	.99	HDSP-3400	Common Anode-red	.800	1.50
MAN 6640	Common Cathode-orange-D.D.	.560	.99	HDSP-3403	Common Cathode red	.800	1.50
MAN 6650	Common Cathode-orange ± 1	.560	.99	5082-7300	4 x 7 sgl. Digit-RHDP	.600	19.95
MAN 6660	Common Anode-orange	.560	.99	5082-7302	4 x 7 Sgl. Digit-LHDP	.600	19.95
MAN 6680	Common Cathode-orange	.560	.99	5082-7304	Overrange character (±1)	.600	15.00
MAN 6710	Common Anode-red-D.D.	.560	.99	5082-7340	4 x 7 Sgl. Digit-Hexadecimal	.600	22.50

RCA LINEAR

CA3013T	2.15	CA3082N	2.00
CA2023T	3.25	CA3083N	1.60
CA3035T	2.48	CA3086N	.85
CA3039T	1.35	CA3089N	3.75
CA3046N	1.30	CA3130T	1.39
CA3059N	3.25	CA3140T	1.25
CA3060N	3.25	CA3160T	1.25
CA3080T	1.25	CA3401N	.59
CA3081N	2.00	CA3600N	3.50

CALCULATOR CHIPS/DRIVERS

MM5725	$2.95
MM5738	2.95
DM8864	2.00
DM8865	1.00
DM8887	.75
DM8889	.75
9374 7-seg. LED driver	1.50
MM5309	4.95

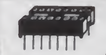
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MM5309	4.95
MM5311	4.95
MM5312	4.95
MM5314	4.95
MM5316	6.95
MM5318	9.95
MM5369	2.95
MM5387/1998a	4.95
CT 7001	6.95

MOTOROLA

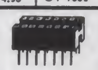
MC1408L7	4.95
MC1408L8	5.75
MC1439L	2.95
MC3022P	2.95
MC3061P	3.50
MC4016(74416)	7.50
MC4024P	3.95
MC4040P	6.95
MC4044P	4.50

LOW PROFILE (TIN) SOCKETS



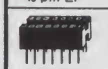
	1-24	25-49	50-100
8 pin LP	.17	.16	.15
14 pin LP	.20	.19	.18
16 pin LP	.22	.21	.20
18 pin LP	.29	.28	.27
20 pin LP	.34	.32	.30
22 pin LP	.37	.36	.35
24 pin LP	.38	.37	.36
28 pin LP	.45	.44	.43
36 pin LP	.60	.59	.58
40 pin LP	.63	.62	.61

SOLDERTAIL STANDARD (TIN)



	1-24	25-49	50-100
14 pin ST	.27	.25	.24
16 pin ST	.30	.27	.25
18 pin ST	.35	.32	.30
24 pin ST	.49	.45	.42
28 pin ST	.99	.90	.81
36 pin ST	1.39	1.26	1.15
40 pin ST	1.59	1.45	1.30

SOLDERTAIL (GOLD) STANDARD



	1-24	25-49	50-100
8 pin SG	.39	.35	.31
14 pin SG	.49	.45	.41
16 pin SG	.54	.49	.44
18 pin SG	.59	.53	.48
24 pin SG	.79	.75	.69
28 pin SG	1.10	1.00	.90
36 pin SG	1.65	1.40	1.26
40 pin SG	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3



	1-24	25-49	50-100
8 pin WW	.59	.54	.49
10 pin WW	.69	.63	.58
14 pin WW	.79	.73	.67
16 pin WW	.85	.77	.70
18 pin WW	.99	.90	.81
20 pin WW	1.19	1.08	.99
22 pin WW	1.49	1.35	1.23
24 pin WW	1.39	1.26	1.14
28 pin WW	1.69	1.53	1.38
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1/4 WATT RESISTOR ASSORTMENTS – 5%

ASST. 1	5 ea.	10 OHM / 27 OHM	12 OHM / 33 OHM	15 OHM / 39 OHM	18 OHM / 47 OHM	22 OHM / 56 OHM	50 PCS	$1.75
ASST. 2	5 ea.	68 OHM / 180 OHM	82 OHM / 220 OHM	100 OHM / 270 OHM	120 OHM / 330 OHM	150 OHM / 390 OHM	50 PCS	1.75
ASST. 3	5 ea.	470 OHM / 1.2K	560 OHM / 1.5K	680 OHM / 1.8K	820 OHM / 2.2K	1K / 2.7K	50 PCS	1.75
ASST. 4	5 ea.	3.3K / 8.2K	3.9K / 10K	4.7K / 12K	5.6K / 15K	6.8K / 18K	50 PCS	1.75
ASST. 5	5 ea.	22K / 56K	27K / 68K	33K / 82K	39K / 100K	47K / 120K	50 PCS	1.75
ASST. 6	5 ea.	150K / 390K	180K / 470K	220K / 560K	270K / 680K	330K / 820K	50 PCS	1.75
ASST. 7	5 ea.	1M / 2.7M	1.2M / 3.3M	1.5M / 3.9M	1.8M / 4.7M	2.2M / 5.6M	50 PCS	1.75

ASST. 8R Includes Resistor Assortments 1-7 (350 PCS.) **$9.95 ea.**

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6-80

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AY-5-2376	Keyboard Encoder (88 keys)	14.95
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74C922	Keyboard Encoder (16 keys)	7.95
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ICM7045	CMOS Precision Timer	24.95
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ICM7208	Seven Decade Counter	19.95
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TL494CN	Switching Regulator	4.49
TL496CP	Single Switching Regulator	1.75
11C90	Divide 10/11 Prescaler	19.95
95H90	Hi-Speed Divide 10/11 Prescaler	11.95
4N33	Photo-Darlington Opto-Isolator	3.95
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XR-L555	1.50	JE2206KB	19.95	XR3403	1.25
XR555	.39	XR1800	3.20	XR4136	1.25
XR556	.99	XR2206	4.40	XR4151	3.95
XR567CP	.99	XR2207	3.85	XR4194	4.95
XR567CT	1.25	XR2208	5.20	XR4202	3.60
XR1310P	1.95	XR2209	1.75	XR4212	2.05
XR1468CN	3.85	XR2211	5.25	XR4558	.75
XR1488	1.95	XR2212	4.35	XR4739	1.15
XR1489	1.95	XR2240	3.45	XR4741	1.47

DIODES

TYPE	VOLTS	W	PRICE
1N746	3.3	400m	4/1.00
1N751	5.1	400m	4/1.00
1N752	5.6	400m	4/1.00
1N753	6.2	400m	4/1.00
1N754	6.8	400m	4/1.00
1N757	9.0	400m	4/1.00
1N759	12.0	400m	4/1.00
1N959	8.2	400m	4/1.00
1N965	15	400m	4/1.00
1N5232	5.6	500m	28
1N5234	6.2	500m	28
1N5235	6.8	500m	28
1N5236	7.5	500m	28
1N5242	12	500m	28
1N5245	15	500m	28
1N456	25	40m	6/1.00
1N458	150	7m	6/1.00
1N485A	180	10m	5/1.00
1N4001	50 PIV 1 AMP		12/1.00

TYPE	VOLTS	W	PRICE
1N4002	100 PIV 1 AMP		12/1.00
1N4003	200 PIV 1 AMP		12/1.00
1N4004	400 PIV 1 AMP		12/1.00
1N4005	600 PIV 1 AMP		10/1.00
1N4006	800 PIV 1 AMP		10/1.00
1N4007	1000 PIV 1 AMP		10/1.00
1N3600	50	200m	6/1.00
1N4148	75	10m	15/1.00
1N4154	35	10m	12/1.00
1N4733	5 1	1w	28
1N4734	5.6	1w	28
1N4735	6.2	1w	28
1N4736	6.8	1w	28
1N4738	8.2	1w	28
1N4742	12	1w	28
1N4744	15	1w	28
1N1183	50 PIV 35 AMP		1.60
1N1184	100 PIV 35 AMP		1.70
1N1185	150 PIV 35 AMP		1.70
1N1186	200 PIV 35 AMP		1.80
1N1188	400 PIV 35 AMP		3.00

SCR AND FW BRIDGE RECTIFIERS

C36D	15A @ 400V	SCR(2N1849)	$1.95
C36M	35A @ 600V	SCR	1.95
2N2328	1.6A @ 300V	SCR	.50
MDA 980-1	12A @ 50V	FW BRIDGE REC.	1.95
MDA 980-3	12A @ 200V	FW BRIDGE REC.	1.95

TRANSISTORS

C106B1	.50			2N3904	4/1.00
MPSA05	.30	2N3055	.89	2N3905	4/1.00
MPSA06	5/1.00	MJE3055	1.00	2N3906	4/1.00
TIS97	6/1.00	2N3392	5/1.00	2N4013	3/1.00
TIS98	6/1.00	2N3398	5/1.00	2N4123	6/1.00
40409	1.75	PN3567	3/1.00	PN4249	4/1.00
40410	1.75	PN3568	4/1.00	PN4250	4/1.00
40673	1.75	PN3569	4/1.00	2N4400	4/1.00
2N918	4/1.00	MPS3638A	5/1.00	2N4401	4/1.00
2N2219A	2/1.00	MPS3702	5/1.00	2N4402	4/1.00
2N2221A	4/1.00	2N3704	5/1.00	2N4403	4/1.00
2N2222A	5/1.00	MPS3704	5/1.00	2N4409	5/1.00
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2N2369A	4/1.00	MPS3705	5/1.00	2N5087	4/1.00
MPS2369	5/1.00	2N3706	5/1.00	2N5088	4/1.00
2N2484	4/1.00	MPS3706	5/1.00	2N5089	4/1.00
2N2906	4/1.00	2N3707	5/1.00	2N5129	5/1.00
2N2907	5/1.00	2N3711	5/1.00	PN5134	5/1.00
		2N3724A	.65	PN5138	5/1.00
2N2925	5/1.00	2N3725A	1.00	2N5139	5/1.00
MJE2955	1.25	2N3772	2.25	2N5210	5/1.00
2N3053	2/1.00	2N3823	1.00	2N5449	3/1.00
		2N3903	5/1.00	2N5951	3/1.00

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

	1-9	10-99	100+		1-9	10-99	100+
10 pf	.05	.04	.03	.001µF	.05	.04	.035
22 pf	.05	.04	.03	.0047µF	.05	.04	.035
47 pf	.05	.04	.03	.01µF	.05	.04	.035
100 pf	.05	.04	.03	.022µF	.06	.05	.04
220 pf	.05	.04	.03	.047µF	.06	.05	.04
470 pf	.05	.04	.035	.1µF	.12	.09	.075

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.0022	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	10	.07	.22mf	.33	.27	.22

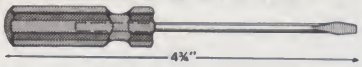
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.22/35V	.39	.31	.25	3.3/25V	.53	.43	.34
.33/35V	.39	.31	.25	4.7/25V	.63	.51	.41
.47/35V	.39	.31	.25	6.8/25V	.79	.63	.50
.68/35V	.39	.31	.25	15/25V	1.39	1.12	.89
1.0/35V	.39	.31	.25	22/6V	.79	.63	.50

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Axial Lead	1-9	10-99	100+	Radial Lead	1-9	10-99	100+
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3.3/50V	.14	.12	.09	1.0/16V	.15	.13	.10
4.7/25V	15	.13	.10	1.0/25V	.16	.14	.11
10/25V	15	.13	10	1.0/50V	.16	.14	.11
10/50V	.16	.14	.12	4.7/16V	.15	.13	.10
22/25V	.17	.15	.12	4.7/25V	.15	.13	.10
22/50V	.24	.20	.18	4.7/50V	.16	.14	.11
47/25V	.19	.17	.15	10/16V	.14	.12	.09
47/50V	.25	.21	19	10/25V	.15	.13	.10
100/25V	.24	.20	.18	10/50V	.16	.14	.12
100/50V	.35	.30	.28	47/50V	.24	.21	.19
220/25V	.32	.28	.25	100/16V	.19	.15	.14
220/50V	.45	.41	.38	100/25V	.24	.20	.18
470/25V	.33	.29	.27	100/50V	.35	.30	.28
1000/16V	.55	.50	45	220/16V	.23	.17	.16
2200/16V	.70	.62	.55	470/25V	.31	.28	.26

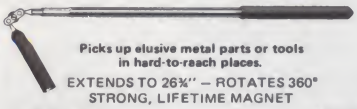
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1000's OF USES – 1/8" TIP ..... 2/$1.00

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Picks up elusive metal parts or tools in hard-to-reach places.

EXTENDS TO 26¾" – ROTATES 360°
STRONG, LIFETIME MAGNET

MRT-2281 ..... $3.95

CSC CONTINENTAL SPECIALTIES

LOGIC PROBE KIT



SPECIFICATIONS

Input Impedance: 300,000 Ohms.
Thresholds: "Lo" 30%Vcc – "Hi" 70%Vcc
Maximum Speed: 300 nsec., 1.5MHz
Input Protection: ±50VDC continuous 117VAC for 15 sec.
Power: 30mA @5V – 40mA @ 15V – 25V max. reverse voltage protected; 36" cable with color coded clips included.
Operating Temp.: 0-50°C.
Dimensions: 5.8L x 1.0W x 0.7D in. (147 x 25 x 18mm)
Weight: 30 oz. (85 gm)

LPK-1 ..... $21.95/Kit

Proto Clips



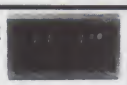
14-PIN CLIP	PC-14	.... $ 4.50
16-PIN CLIP	PC-16	.... $ 4.75
24-PIN CLIP	PC-24	.... $10.00
40-PIN CLIP	PC-40	.... $16.00

Proto Boards



PB-6	$17.95
PB-100	19.95
PB-101	22.95
PB-102	26.95
PB-103	44.95
PB-104	55.95
PB-203	99.95
PB-203A	155.00
PB-203A-Kit	131.00

Jumbo 6-Digit Clock Kit



- Four .630"ht. and two .300"ht. common anode displays
- Uses MM5314 clock chip
- Switches for hours, minutes and hold functions
- Hours easily viewable to 30 feet
- Simulated walnut case
- 115 VAC operation
- 12 or 24 hour operation
- Includes all components, case and wall transformer
- Size: 6¾ x 3⅛ x 1¾

JE747 ..... $29.95

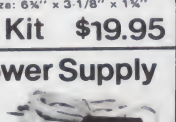


- Bright .300 ht. comm. cathode display
- Uses MM5314 clock chip
- Switches for hours, minutes and hold modes
- Hrs. easily viewable to 20 ft.
- Simulated walnut case
- 115 VAC operation
- 12 or 24 hr. operation
- Incl. all components, case & wall transformer
- Size: 6¾" x 3-1/8" x 1¾"

JE701

6-Digit Clock Kit $19.95

Regulated Power Supply



Uses LM309K. Heat sink provided. PC board construction. Provides a solid 1 amp @ 5 volts. Can supply up to ±5V, ±9V and ±12V with JE205 Adapter. Includes components, hardware and instructions. Size: 3½" x 5" x 2"H

JE200 ..... $14.95



ADAPTER BOARD
—Adapts to JE200—
±5V, ±9V and ±12V

DC/DC converter with +5V input. Toriodal hi-speed switching XMFR. Short circuit protection. PC board construction. Piggy-back to JE 200 board. Size: 3½" x 2" x 9/16"H

JE205 ..... $12.95

MICROPROCESSOR COMPONENTS

8080A/8080A SUPPORT DEVICES

8080A	CPU	$ 7.95
8212	8-Bit Input/Output	3.25
8214	Priority Interrupt Control	5.95
8216	Bi-Directional Bus Driver	3.49
8224	Clock Generator/Driver	3.95
8226	Bus Driver	3.49
8228	System Controller/Bus Driver	4.95
8238	System Controller	5.95
8251	Prog. Comm. 1/0 (USART)	7.95
8253	Prog. Interval Timer	14.95
8255	Prog. Periph. 1/0 (PPI)	9.95
8257	Prog. DMA Control	19.95
8259	Prog. Interrupt Control	19.95

6800/6800 SUPPORT DEVICES

MC6800	MPU	$14.95
MC6802CP	MPU with Clock and Ram	24.95
MC6810API	128X8 Stetic Ram	5.95
MC6821	Periph. Inter. Adapt (MC6820)	7.49
MC6828	Priority Interrupt Controller	12.95
MC6830L8	1024X8 Bit ROM (MC68A30-8)	14.95
MC6850	Asynchronous Comm. Adapter	7.95
MC6852	Synchronous Serial Data Adapt.	9.95
MC6860	0-600 bps Digital MODEM	12.95
MC6862	2400 bps Modulator	14.95
MC6880A	Quad 3-State Bus Trans. (MC8T26)	2.25

MICROPROCESSOR CHIPS—MISCELLANEOUS

Z80(780C)	CPU	$13.95
Z80A(780-1)	CPU	15.95
CDP1802	CPU	19.95
2650	MPU	19.95
6502	CPU	11.95
8035	8-Bit MPU w/clock, RAM, 1/0 lines	19.95
P8085	CPU	19.95
TMS9900JL	16-Bit MPU w/hardware, multiply & divide	49.95

SHIFT REGISTERS

MM500H	Dual 25 Bit Dynemic	$ .50
MM503H	Dual 50 Bit Dynamic	.50
MM504H	Dual 16 Bit Static	.50
MM506H	Dual 100 Bit Static	.50
MM510H	Dual 64 Bit Accumulator	.50
MM5016H	500/512 Bit Dynamic	.89
2504T	1024 Dynamic	3.95
2518	Hex 32 Bit Static	4.95
2522	Dual 132 Bit Static	2.95
2524	512 Static	.99
2525	1024 Dynamic	2.95
2527	Dual 256 Bit Static	2.95
2528	Dual 250 Static	4.00
2529	Dual 240 Bit Static	4.00
2532	Quad 80 Bit Static	2.95
3341	Fifo	6.95
74LS670	4X4 Register File (TriState)	2.49

UART'S

A-Y-5-1013	30K BAUD	5.95

MICROPROCESSOR MANUALS

M-Z80	User Manual	$7.50
M-CDP1802	User Manual	7.50
M-2650	User Manual	5.00

ROM'S

2513(2140)	Character Generator(upper case)	$9.95
2513(3021)	Character Generator(lower case)	9.95
2516	Character Generator	10.95
MM5230N	2048-Bit Read Only Memory	1.95

RAM'S

1101	256X1	Static	$1.49
1103	1024X1	Dynamic	.99
2101(8101)	256X4	Static	3.95
2102	1024X1	Static	1.75
21L02	1024X1	Static	1.95
2111(8111)	256X4	Static	3.95
2112	256X4	Static MOS	4.95
2114	1024X4	Static 450ns	7.95
2114L	1024X4	Static 450ns low power	10.95
2114-3	1024X4	Static 300ns	10.95
2114L-3	1024X4	Static 300ns low power	11.95
5101	256X4	Static	7.95
5280/2107	4096X1	Dynamic	4.95
7489	16X4	Static	1.75
74S200	256X1	Static Tristate	4.95
93421	256X1	Static	2.95
UPD414 (MK4027)	4K	Dynamic 16 pin	4.95
UPD416 (MK4116)	16K	Dynamic 16 pin 250ns	9.95
TMS4044-45NL	4K	Static	14.95
TMS4045	1024X4	Static	14.95
2117	16,384X1	Dynamic 350ns (house marked)	9.95
MM5262	2KX1	Dynamic	4/1.00

PROM'S

1702A	2048	FAMOS	$5.95
2716INTEL	16K*	EPROM	59.95
TMS2516	16K*	EPROM	39.95
(2716)	*Requires single +5V power supply		
TMS2532	4KX8	EPROM	89.95
2708	8K	EPROM	10.95
2716 T.I	16K**	EPROM	29.95
	**Requires 3 voltages,—5V, +5V, +12V		
5203	2048	FAMOS	14.95
6301-1(7611)	1024	Tristate Bipolar	3.49
6330-1(7602)	256	Open C Bipolar	2.95
82S23	32X8	Open Collector	3.95
82S115	4096	Bipolar	19.95
82S123	32X8	Tristate	3.95
74186	512	TTL Open Collector	9.95
74188	256	TTL Open Collector	3.95
74S287	1024	Static	2.95

JE600 HEXADECIMAL ENCODER KIT



FEATURES:
- Full 8 bit latched output for microprocessor use
- 3 User Define keys with one being bi-stable operation
- Debounce circuit provided for all 19 keys
- LED readout to verify entries
- Easy interfacing with standard 16 pin IC connector
- Only +5VDC required for operations

FULL 8 BIT LATCHED OUTPUT—19 KEYBOARD

The JE600 Encoder Keyboard provides two separate hexadecimal digits produced from sequential key entries to allow direct programming for 8 bit microprocessor or 8 bit memory circuits. Three (3) additional keys are provided for user operations with one having a bistable output available. The outputs are latched and monitored with LED readouts. Also included is a key entry strobe.

JE600 ..... $59.95
Hexadecimal Keypad only $14.95

DIGITAL THERMOMETER KIT



- Dual sensors—switching control for indoor/outdoor or dual monitoring
- Continuous LED .8" ht. display
- Range: -40°F to 199°F / -40°C to 100°C
- Accuracy: ±1° nominal
- Set for Fahrenheit or Celsius reading
- Sim. walnut case - AC wall adapter incl.
- Size: 3-1/4"H x 6-5/8"W x 1-3/8"D

JE300 ..... $39.95

62-Key ASCII Encoded Keyboard Kit



The JE610 62-Key ASCII Encoded Keyboard Kit can be interfaced into most any computer system. The JE610 Kit comes complete with an industrial grade keyboard switch assembly (62 keys), IC's, sockets, connector, electronic components and a double-sided printed wiring board. The keyboard assembly requires +5V @ 150mA and –12V @ 10mA for operation.

FEATURES:
- 60 Keys generate the full 128 characters, upper and lower case ASCII set
- Fully buffered
- 2 user-define keys provided for custom applications
- Caps lock for upper case only alpha characters
- Utilizes a 2376 (40 pin) encoder read only memory chip
- Outputs directly compatible with TTL/DTL or MOS logic arrays
- Easy interfacing with a 16-pin dip or 18-pin edge connector

JE610 ..... $79.95
62-Key Keyboard only .. $34.95

HICKOK LX303 Portable LCD Digital Multimeter



- Big ½ inch high, 3½ Digit Liquid Crystal Display
- Over 200 Hours of operation with a 9V battery
- Automatic zero, polarity and overrange indication
- 100mV DC F.S. sensitivity
- ±1% basic accuracy
- 19 ranges and functions
- Rugged Cycolac® case and removable cover, stores test lead set.
- Full one year warranty.

SPECIFICATIONS: DC volts (8 ranges) .0 1mV to 1000V Accuracy ±0.5% rdg ±0.5% f.s. Input impedd 10MΩ Max input 1kV except 500V on 200mV range
AC Volts (40Hz to 5kHz) .0 1V to 600V. Accuracy ±1.0% rdg ±0.5% f.s. (–2dB max at 5kHz). Max input 600V Rms
Resistance (8 Low Power Ranges) .0 1 to 20MΩ Accuracy ±0.5% rdg ±0.5% f.s. (±1.5% rdg on 20MΩ range) Input protected to 120V AC on ranges
DC Current (8 ranges) .01nA to 100mA Accuracy ±1.0% rdg ±0.5% f.s.
Dimensions and Weight .5-7/8" x 3-3/8" x 1-3/4" .8 oz. POWER 9V battery (not included) or Hickok AC adapter
READ RATE .3/sec

LX303	1% ACCURACY	$74.95
LX304	.5% ACCURACY	$89.95

PART NO.	DESCRIPTION	PRICE
RC-3	115V AC ADAPTER	7.50
CC-3	PADDED CARRYING CASE	7.50
VP-10	X10 DC PROBE ADAPTER (Up to 10K)	14.95
VP-40	40kV DC PROBE	35.00
CS-1	10 Amp DC Current Shunt	14.95

$10.00 Min. Order – U.S. Funds Only
Calif. Residents Add 6% Sales Tax
Postage – Add 5% plus $1 Insurance (if desired)

Spec Sheets – 25¢
1980 Catalog Available – Send 41¢ stamp

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41

The Incredible "Pennywhistle 103"



$139.95 Kit Only

The Pennywhistle 103 is capable of recording data to and from audio tape without critical speed requirements for the recorder and it is able to communicate directly with another modem and terminal for telephone "hamming" and communications. In addition, it is free of critical adjustments and is built with non-precision, readily available parts.

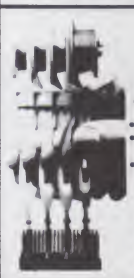
Data Transmission Method	Frequency-Shift Keying, full-duplex (half-duplex selectable).
Maximum Data Rate	300 Baud.
Data Format	Asynchronous Serial (return to mark level required between each character).
Receive Channel Frequencies	.2025 Hz for space, 2225 Hz for mark.
Transmit Channel Frequencies	.Switch selectable. Low (normal) = 1070 space, 1270 mark. High = 025 space, 2225 mark.
Receive Sensitivity	–46 dbm accoustically coupled.
Transmit Level	–15 dbm nominal. Adjustable from –6 dbm to –20 dbm.
Receive Frequency Tolerance	.Frequency reference automatically adjusts to allow for operation between 1800 Hz and 2400 Hz.
Digital Data Interface	.EIA RS-232C or 20 mA current loop (receiver is optoisolated and non-polar).
Power Requirements	.120 VAC, single phase, 10 Watts.
Physical	.All components mount on a single 5" by 9" printed circuit board. All components included.

Requires a VOM, Audio Oscillator, Frequency Counter and/or Oscilloscope to align.

TRS-80 16K Conversion Kit

Expand your 4K TRS-80 System to 16K.
Kit comes complete with:
* 8 each UPD416-1 (16K Dynamic Rams) 250NS
* Documentation for conversion

TRS-16K $75.00



ok JUST WRAP™

- 30 AWG wire
- Daisy chain or point-to-point
- No stripping or slitting required—just wrap
- .025" square posts
- Built-in cut off
- Includes 50 ft. wire

Part No.	Wire Color	Price
JW-1-B	Blue	$14.95
JW-1-W	White	14.95
JW-1-Y	Yellow	14.95
JW-1-R	Red	14.95

JUST WRAP™ Replacement Wire

Part No.	Color		Price
R-JW-B	Blue	50 ft. roll	$2.98
R-JW-W	White	50 ft. roll	2.98
R-JW-Y	Yellow	50 ft. roll	2.98
R-JW-R	Red	50 ft. roll	2.98

JUST WRAP™ Unwrap Tool $3.49

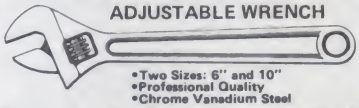


ok Vacuum Vise

Vacuum-based light-duty vise for small components and assemblies. ABS construction. 1½" jaws, 1¼" travel. Can be permanantly installed.

VV-1 ..... $3.49

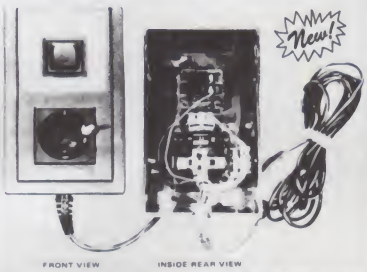
ADJUSTABLE WRENCH



- Two Sizes: 6" and 10"
- Professional Quality
- Chrome Vanadium Steel

6"– AW-6 .. $4.95 10"– AW-10 .. $6.95

JOYSTICK VIDEO CONTROLLER



FRONT VIEW INSIDE REAR VIEW

- IDEAL FOR ALL VIDEO GAMES OR REMOTE CONTROL PROJECTS
- SMALL CASE SIZE: 1-1/2"H x 2-3/8"W x 4-5/16"L
- 2 MINIATURE POTENTIOMETERS—40K OHM EACH
- SPST PUSH BUTTON CONTROL
- 5-WIRE CONNECTION CABLE – 5 FEET LONG
- RUGGED PLASTIC CASE

JVC-40 ..... $4.95 each

IT'S HERE . . . AND CPU BOARDS WILL NEVER BE THE SAME AGAIN.

The **CompuPro Dual Processor Board** gives true 16 bit power with an 8 bit bus, is downward compatible with the vast library of 8080 software, is upward compatible with hardware and software not yet developed, accesses 16 Megabytes of memory, meets all IEEE S-100 bus specifications, runs 8085 and 8086 code **in your existing mainframe** as well as Microsoft 8086 BASIC and Sorcim PASCAL/M™, and runs at 5 MHz for speed as well as power.

The **Dual Processor Board** has two CPUs that "talk" to each other; the 8088 CPU is an 8 bit bus version of the 8086 16 bit CPU, while the 8085 is an advanced 8 bit CPU that can run existing software such as CP/M.

Amazingly enough, all this flexibility won't break your budget: **introductory prices** are **$385 unkit, $495 assembled,** and **$595** qualified under the **Certified System Component** high-reliability program. **Don't need 16 bit power yet?** Then select our **single processor** version which does not inlcude the 8088 for **$235 unkit, $325 assembled,** and **$425 CSC.**

The **Dual Processor Board** is built to the same stringent standards that have established our leadership in S-100 system components . . . and starting June 1st, you'll be able to plug it into your mainframe to experience computing power that, until now, you could only dream about. CPU boards will truly never be the same again.

THINKING GRAPHICS? THINK "SPECTRUM" COLOR GRAPHICS BOARD.

The **CompuPro Spectrum board** is actually three sophisticated products in one: a fast (5 MHz), low power 8K × 8 IEEE compatible memory board with extended addressing; an I/O board with full duplex bidirectional parallel port (including latched data along with attention, enable, and strobe bits), capable of interfacing with keyboards, joysticks, or similar parallel peripherals; and a 6847-based graphics generator board that can display all 64 ASCII characters. Put these together, and you've got 10 modes of operation — from alphanumeric/semigraphics in 8 colors to ultra-dense 256 × 192 full graphics. Includes a 75 Ohm RS-170 compatible line output and video output for use with FCC approved video modulators. **Introductory pricing is $339 unkit, $399 assembled,** and **$449** qualified under the high-reliability **CSC** program. **Looking for graphics software?** Sublogic's **2D Universal Graphics Interpreter** (normally $35) is yours for **$25 with the purchase of a Spectrum board in any configuration.**

No longer must you settle for B&W graphics, or stripped down color graphics boards; starting June 1st, you'll be able to plug one of the industry's most cost-effective and full-feature color graphics boards into your S-100 system.

OUTSTANDING COMPUTER PRODUCTS:

MEMORY

All boards are static, run in 5 MHz systems, meet all IEEE standards, include a 1 year limited warranty, and feature low power consumption. Choose from **unkit** (sockets, bypass caps presoldered in place), **assembled,** or boards qualified under our high-reliability **Certified System Component (CSC)** program (200 hour burn-in, 8 MHz operation, and extremely low power consumption.

Name	Buss & Notes	Unkit	Assm	CSC
8K Econoram* IIA	S-100	$169	$189	$239
16K Econoram XIV	S-100 (1)	$299	$349	$429
16K Econoram X-16	S-100	$329	$379	$479
16K Econoram XIIIA-16	S-100 (2)	$349	$419	$519
16K Econoram XV-16	H8 (3)	$339	$399	n/a
24K Econoram XIIIA-24	S-100 (2)	$479	$539	$649
32K Econoram X-32	S-100	$599	$689	$789
32K Econoram XIIIA-32	S-100 (2)	$649	$729	$849
32K Econoram XV-32	H8 (3)	$649	$749	n/a
32K Econoram XI	SBC/BLC	n/a	n/a	$1050

* **Econoram** is a trademark of **Bill Godbout Electronics.**

(1) Extended addressing (24 address lines). Addressable on 4K boundaries.
(2) Compatible with all bank select systems (Cromemco, Alpha Micro, Etc.); addressable on 4K boundaries.
(3) Bank select option for implementing memory systems greater than 64K.

SPECIAL PRICE!

TRS-80* -I or -II MEMORY EXPANSION CHIP SET: $69!

We've done it again . . . 8 low power, 250 ns 16K dynamic RAMs at a trendsetting price. Don't be impressed with fancy packaging or four color ads; our chip set gives all the performance you want at a price you can afford. **Offer good while supplies last.** Add $3 for TRS-80 compatible DIP shunts and complete installation instructions.

*TRS-80 is a trademark of the Tandy Corporation.

TERMS: Cal res add tax. Allow 5% for shipping, excess refunded. VISA®/Mastercharge® call our 24 hour order desk at **(415) 562-0636.** COD OK with street address for UPS. Sale prices good through cover month of magazine; other prices are subject to change without notice.

MOTHERBOARDS

Meet or exceed all IEEE S-100 specs; with true active termination, grounded Faraday shield, edge connectors for all slots. Unkits have edge connectors and termination resistors pre-soldered in place for easy assembly.

6 slot: $89 unkit, $129 assm.
12 slot: $129 unkit, $169 assm.
19 slot: $174 unkit, $214 assm.

GODBOUT COMPUTER BOX $289 desktop, $329 rack mount. With quiet fan, dual AC outlets and fuseholder, line filter, card guide, etc.

S-100 2708 EROM BOARD $85 unkit. 4 independently addressable 4K blocks. Includes support chips and manual, but no EROMs.

S-100 ACTIVE TERMINATOR BOARD $34.50 kit. Plugs into older, unterminated motherboards to improve performance.

S-100 MEMORY MANAGER BOARD $59 unkit, $85 assm, $100 CSC. Adds bank select and extended addressing to older S-100 machines to dramatically increase the available memory space.

2S "INTERFACER I" S-100 I/O BOARD $199 unkit, $249 assm, $324 CSC. Dual RS-232 ports with full handshake. Onboard crystal timebase, hardware UARTS, much more.

3P PLUS S "INTERFACER II" I/O BOARD $199 unkit, $249 assm, $324 CSC. Includes 1 channel of serial I/O (RS-232 with full handshake), along with 3 full duplex parallel ports plus a separate status port.

PASCAL/M™ + MEMORY SPECIAL PASCAL can give a microcomputer with CP/M more power than many minis. You can buy our totally standard **Wirth PASCAL/M™ 8" diskette,** with **manual** and **Wirth's definitive book** on PASCAL, FOR **$150 with the purchase of any memory board.** Specify Z-80 or 8080/8085 version. PASCAL/M™ available separately for $350.

Z-80A CPU BOARD $225 unkit, $295 assm, $395 CSC. Full compliance with IEEE S-100 bus standards, provision for adding two EROMs, on-board fully maskable interrupts, power on jump and clear, selectable automatic wait state insertion, IEEE extended addressing, much more.

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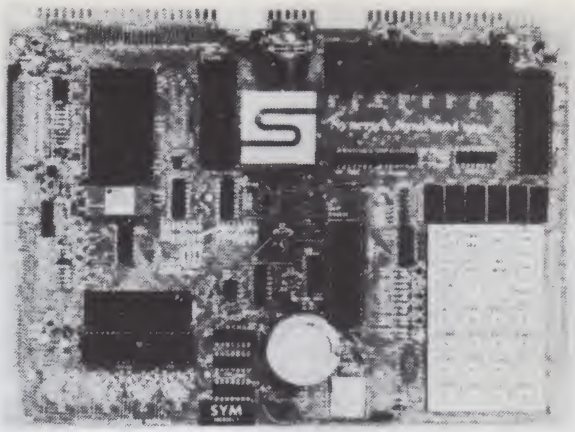
CompuPro™ from GODBOUT ELECTRONICS

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Many of these products are stocked by finer computer stores world-wide, or write us for further information if there's no dealer in your area.

SYM-1, 6502-BASED MICROCOMPUTER

- FULLY-ASSEMBLED AND COMPLETELY INTEGRATED SYSTEM that's ready-to-use
- ALL LSI IC'S ARE IN SOCKETS
- 28 DOUBLE-FUNCTION KEYPAD INCLUDING UP TO 24 "SPECIAL" FUNCTIONS
- EASY-TO-VIEW 6-DIGIT HEX LED DISPLAY
- KIM-1* HARDWARE COMPATIBILITY
  The powerful 6502 8-Bit MICROPROCESSOR whose advanced architectural features have made it one of the largest selling "micros" on the market today.
- THREE ON-BOARD PROGRAMMABLE INTERVAL TIMERS available to the user, expandable to five on-board.
- 4K BYTE ROM RESIDENT MONITOR and Operating Programs.
- Single 5 Volt power supply is all that is required.
- 1K BYTES OF 2114 STATIC RAM onboard with sockets provided for immediate expansion to 4K bytes onboard, with total memory expansion to 65, 536 bytes.
- USER PROM/ROM: The system is equipped with 3 PROM/ROM expansion sockets for 2316/2332 ROMs or 2716 EPROMs
- ENHANCED SOFTWARE with simplified user interface
- STANDARD INTERFACES INCLUDE:
  —Audio Cassette Recorder Interface with Remote Control (Two modes: 135 Baud KIM-1* compatible, Hi-Speed 1500 Baud)
  —Full duplex 20mA Teletype Interface
  —System Expansion Bus Interface
  —TV Controller Board Interface
  —CRT Compatible Interface (RS-232)
- APPLICATION PORT: 15 Bi-directional TTL Lines for user applications with expansion capability for added lines
- EXPANSION PORT FOR ADD-ON MODULES (51 I/O Lines included in the basic system)
- SEPARATE POWER SUPPLY connector for easy disconnect of the d-c power
- AUDIBLE RESPONSE KEYPAD



Synertek has enhanced KIM-1* software as well as the hardware. The software has simplified the user interface. The basic SYM-1 system is programmed in machine language. Monitor status is easily accessible, and the monitor gives the keypad user the same full functional capability of the TTY user. The SYM-1 has everything the KIM-1* has to offer, plus so much more that we cannot begin to tell you here. So, if you want to know more, the SYM-1 User Manual is available, separately

SYM-1 Complete w/manuals **$229.00**
SYM-1 User Manual Only **$7.00**
SYM-1 Expansion **$60.00**

Expansion includes 3K of 2114 RAM chips and 1-6522 I/O chip.

SYM-1 Manuals: The well organized documentation package is complete and easy-to-understand.

SYM-1 CAN GROW AS YOU GROW. It's the system to BUILD-ON. Expansion features that are available:

BAS-1 8K Basic ROM (Microsoft Basic) **$89.00**
KTM-2 (Complete terminal less monitor) **$319.00**

QUALITY EXPANSION BOARDS DESIGNED SPECIFICALLY FOR KIM-1, SYM-1 & AIM 65

These boards are set up for use with a regulated power supply such as the one below, but, provisions have been made so that you can add onboard regulators for use with an unregulated power supply. But, because of unreliability, we do not recommend the use of onboard regulators. All I.C.'s are socketed for ease of maintenance. *All boards carry full 90-day warranty.*

All products that we manufacture are designed to meet or exceed industrial standards. All components are first qualtiy and meet full manufacturer's specifications. All this and an extended burn-in is done to reduce the normal percentage of field failures by up to 75%. To you, this means the chance of inconvenience and lost time due to a failure is very rare; but, if it should happen, we guarantee a turn-around time of less than forty-eight hours for repair.

Our money back guarantee: If, for any reason you wish to return any board that you have purchased directly from us within ten (10) days after receipt, complete, in original condition, and in original shipping carton; we will give you a complete credit or refund less a $10.00 restocking charge per board.

VAK-1 8-SLOT MOTHERBOARD

This motherboard uses the KIM-4* bus structure. It provides eight (8) expansion board sockets with rigid card cage. Separate jacks for audio cassette, TTY and power supply are provided. Fully buffered bus.

VAK-1 Motherboard **$139.00**

VAK-2/4 16K STATIC RAM BOARD

This board using 2114 RAMs is configured in two (2) separately addressable 8K blocks with individual write-protect switches.

VAK-2 16K RAM Board with only 8K of RAM (½ populated) **$239.00**
VAK-3 Complete set of chips to expand above board to 16K **$125.00**
VAK-4 Fully populated 16K RAM **$325.00**

VAK-5 2708 EPROM PROGRAMMER

This board requires a +5 VDC and ±12 VDC, but has a DC to DC multiplyer so there is no need for an additional power supply. All software is resident in on-board ROM, and has a zero-insertion socket.

VAK-5 2708 EPROM Programmer **$249.00**

VAK-6 EPROM BOARD

This board will hold 8K of 2708 or 2758, or 16K of 2716 or 2516 EPROMs. *EPROMs not included.*

VAK-6 EPROM Board **$119.00**

VAK-7 COMPLETE FLOPPY-DISK SYSTEM $1299.00

See May Kilobaud for details

VAK-8 PROTYPING BOARD

This board allows you to create your own interfaces to plug into the motherboard. Etched circuitry is provided for regulators, address and data bus drivers; with a large area for either wire-wrapped or soldered IC circuitry.

VAK-8 Protyping Board **$39.00**

POWER SUPPLIES

ALL POWER SUPPLIES are totally enclosed with grounded enclosures for safety, AC power cord, and carry a full 2-year warranty.

FULL SYSTEM POWER SUPPLY

This power supply will handle a microcomputer and up to 65K of our VAK-4 RAM. ADDITIONAL FEATURES ARE: Over voltage Protection on 5 volts, fused, AC on/off switch. Equivalent to units selling for $225.00 or more.

Provides +5 VDC @ 10 Amps & ±12 VDC @ 1 Amp
VAK-EPS Power Supply **$119.00**

VAK-EPS/AIM—same as VAK-EPS but w/additional 24 volt unregulated (specifically for AIM 65) **$149.00**

KIM-1* Custom P.S. provides 5 VDC @ 1.2 Amps and +12 VDC @ .1 Amps
KCP-1 Power Supply **$39.00**

SYM-1 Custom P.S. provides 5 VDC @ 1.4 Amps
VCP-1 Power Supply **$39.00**

*KIM is a product of MOS Technology

Add $2.50 for shipping & handling for all except AIM 65.

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SN7402N	.22	SN74126N	.44
SN7403N	.22	SN74128N	.59
SN7404N	.22	SN74132N	.89
SN7405N	.23	SN74136N	.95
SN7406N	.23	SN74139N	.95
SN7407N	.23	SN74141N	.69
SN7408N	.26	SN74142N	2.95
SN7409N	.23	SN74143N	2.95
SN7410N	.22	SN74144N	2.95
SN7411N	.29	SN74145N	.62
SN7412N	.29	SN74147N	1.95
SN7413N	.39	SN74148N	1.20
SN7414N	.59	SN74150N	.99
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SN7420N	.22	SN74153N	.67
SN7421N	.35	SN74154N	1.19
SN7422N	.29	SN74155N	.82
SN7423N	.29	SN74156N	.89
SN7425N	.29	SN74157N	.69
SN7426N	.29	SN74158N	1.65
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SN7448N	.79	SN74179N	1.80
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SN7480N	.59	SN74196N	.85
SN7481N	1.10	SN74197N	.85
SN7482N	1.10	SN74198N	1.39
SN7483N	.55	SN74199N	1.39
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CD4014	1.39	CD4502	1.65
CD4015	1.39	CD4503	.69
CD4016	.59	CD4505	8.95
CD4017	1.19	CD4506	.75
CD4018	1.19	CD4507	.95
CD4019	.49	CD4508	3.95
CD4020	1.19	CD4510	1.39
CD4021	1.49	CD4511	1.39
CD4022	1.29	CD4512	1.39
CD4023	.38	CD4515	3.95
CD4024	.79	CD4516	1.69
CD4025	.38	CD4518	1.39
CD4027	.79	CD4520	1.39
CD4028	.99	CD4555	4.95
CD4029	1.29	CD4556	.99
CD4030	.69	CD4566	2.25
CD4031	3.25	74C00	.39
CD4032	2.15	74C02	.39
CD4034	3.25	74C04	.39
CD4035	1.19	74C08	.49
CD4037	1.95	74C10	.49
CD4047	1.25	74C14	1.65
CD4041	1.25	74C20	.39
CD4042	.99	74C30	.39
CD4043	.99	74C32	.99
CD4044	.99	74C42	1.85
CD4046	2.25	74C48	2.39
CD4047	1.25	74C73	.99
CD4048	.69	74C74	.99
CD4049	.69	74C85	2.49
CD4050	.69	74C89	4.95
CD4051	1.10	74C90	1.85
CD4052	1.10	74C93	1.85
CD4053	1.10	74C95	1.85
CD4055	3.95	74C107	1.19
CD4056	2.95	74C151	2.49
CD4059	9.95	74C154	3.50
CD4060	1.39	74C157	2.10
CD4066	.89	74C160	2.39
CD4069	.35	74C161	2.30
CD4070	.69	74C163	2.39
CD4071	.35	74C164	2.39
CD4072	.35	74C173	2.59
CD4073	.35	74C174	2.75
CD4075	.35	74C175	2.75
CD4076	1.29	74C192	2.39
CD4077	.35	74C193	2.39
CD4078	.35	74C195	2.39
CD4081	.35	74C922	7.95
CD4082	.35	74C923	6.95
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74LS00N	.35	74LS164N	1.19
74LS01N	.28	74LS165N	.89
74LS02N	.28	74LS166N	2.48
74LS03N	.28	74LS168N	1.89
74LS04N	.39	74LS169N	1.89
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74LS27N	.39	74LS221N	1.49
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74LS30N	.26	74LS241N	2.49
74LS32N	.39	74LS242N	2.29
74LS37N	.79	74LS243N	2.29
74LS38N	.39	74LS244N	2.95
74LS40N	.26	74LS245N	8.95
74LS42N	.79	74LS247N	1.10
74LS47N	.79	74LS248N	1.10
74LS48N	.79	74LS249N	1.89
74LS51N	.26	74LS251N	1.79
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74LS55N	.35	74LS257N	.98
74LS73N	.45	74LS258N	.98
74LS74N	.59	74LS259N	2.95
74LS75N	.68	74LS260N	.69
74LS76N	.45	74LS261N	2.49
74LS78N	.65	74LS266N	.59
74LS83AN	.99	74LS273N	1.75
74LS85N	1.19	74LS275N	4.40
74LS86N	.45	74LS279N	.59
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74LS92N	.75	74LS290N	1.29
74LS93N	.75	74LS293N	1.95
74LS95N	.88	74LS295N	1.10
74LS96N	.98	74LS298N	1.29
74LS107N	.45	74LS324N	1.75
74LS109N	.45	74LS347N	1.95
74LS112N	.49	74LS348N	1.95
74LS113N	.49	74LS352N	1.65
74LS114N	.55	74LS353N	1.85
74LS122N	.55	74LS363N	1.49
74LS123N	1.19	74LS365N	.99
74LS124N	1.35	74LS366N	.99
74LS125N	.89	74LS367N	.99
74LS126N	.89	74LS368N	.99
74LS132N	.79	74LS373N	2.75
74LS136N	.59	74LS374N	2.75
74LS138N	.89	74LS375N	.69
74LS139N	.89	74LS377N	1.95
74LS145N	1.25	74LS385N	1.95
74LS148N	1.49	74LS386N	.65
74LS151N	.79	74LS390N	1.95
74LS153N	.79	74LS393N	1.95
74LS154N	2.49	74LS395N	1.70
74LS155N	1.19	74LS399N	2.95
74LS156N	.99	74LS424N	2.95
74LS157N	.99	74LS668N	1.75
74LS158N	.75	74LS670N	2.29
74LS160N	.98	81LS95N	1.99
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LM320T-XX*	1.25	CA3046T	1.29
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LM323K	4.95	CA3059N	3.25
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LM340T-XX*	1.25	CA3080N	1.29
LM340H-XX*	1.25	CA3081N	1.69
LM344H	1.95	CA3082N	1.69
LM348N	1.85	CA3083N	1.99
LM358CN	.98	CA3086N	1.29
LM360N	1.49	CA3089N	2.75
LM372N	1.95	CA3096N	2.49
LM376N	3.75	CA3097N	1.99
LM377N	3.75	CA3130T	2.49
LM380CN/N	1.25	CA3140T	2.49
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LM739N	1.15	SN75453N	.49
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LM741CN-14	.19	SN75491N	.89
LM747N/H	.79	SN75492N	.89
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LM1310N	1.90		

BECKMAN Digital Multimeters

MODELS TECH 300 AND TECH 310



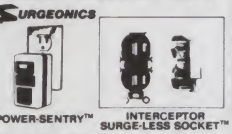
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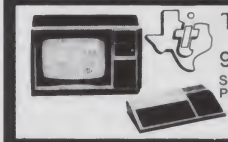


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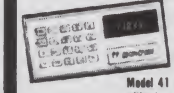
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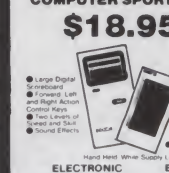
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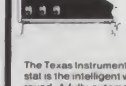


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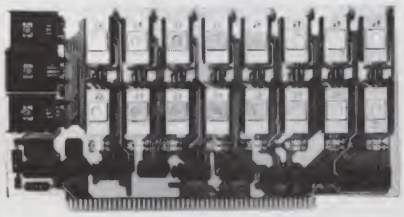
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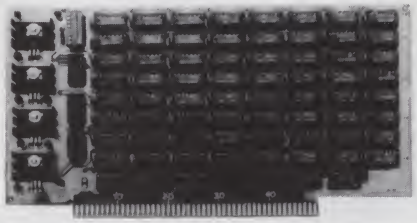
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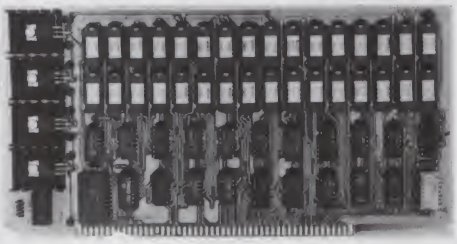
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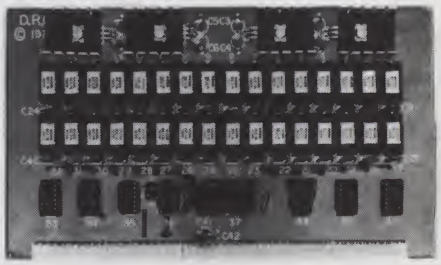
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FOR SWTPC 6800 BUSS!

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SCL Interpreter coming soon! Our new Sound Command Language interpreter along *with the Register* Examine/Modify (REM) routines and Sound Effects Library (SEL) will be available soon in EPROM. SCL makes sound effects programming generally easier and quicker than that written in Basic or Assembly Language. An SCL users group will be formed, and the best new SCL programs submitted will be added to the Sound Effects Library in EPROM.

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4K STATIC RAM'S. MAJOR BRAND, NEW PARTS.
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Perfect for OEM's
S-100 Z80 CPU CARD

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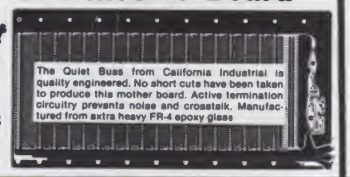
California Digital has resently researched the complete low cost printer market. It is our opinion that the IDS 440 Paper Tiger is, without doubt, the most versatile and offers the best value of any printer costing under $1,000.

This quality dot matrix printer incorporates such features as software selectable character size to allow print densities upto 132 characters per line. Full forms handling capabilities and tractor feed mechansim adjustable to 9.5". The Paper Tiger is engineered to accept either parallel or RS232 serial ASCII. 110/220V.50/60Hz.

***** $995.00 plus shipping *****

S-100 Mother Board

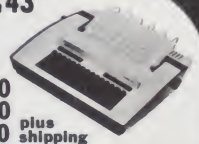
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18 slot
IMSAI

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74	1.49	148	....	240	1.95
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Atari 800	650
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Northstar Quad 32k Horizon	2995
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Compucolor II Model 3	1395
Rockwell Aim 65 (1K)	375

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ADDS Regent 80	1495
Hazeltine 1420	850
Hazeltine 1500	995

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Centronics 730 friction	895
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powered from phone line. 169
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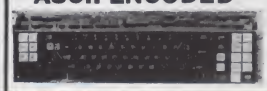
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TRS-80 $ / APPLE II 59

16k memory (8) 4116's



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2114 1Kx4 300	8.95	8.50	8.00	*	*
4044 4Kx1 450	5.95	5.50	5.25	*	*
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8086 Intel 16 bits	85.00	WD 1781 Double D	65.00
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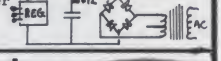
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1702A 2K	4.95	4.50	4.00
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High-resolution screen is capable of displaying 96 upper and lower case ASCII characters and 32 control codes. This terminal is switch selectable to display six European languages.

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your choice

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$.98 ea.	$.88	.81	.73	.66

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7107 jbt	ON-OFF(mnt.ON)
7108 CK	ON-(moment ON)
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Rotary	3P-4-Pos.
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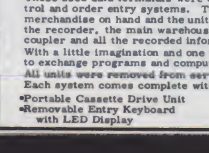
KYNAR WIRE WRAP

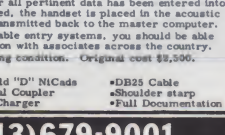
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- Acoustical Coupler
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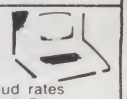
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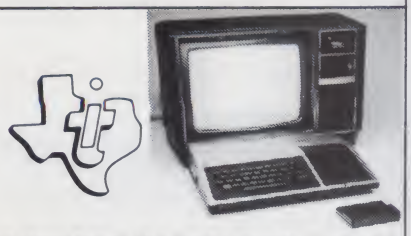
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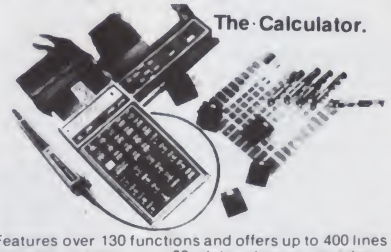
ADM-42. The semi-intelligent terminal that provides you with flexibility of format, security, editing, interface, and transmission. Two-page display standard (Originally expandable to eight) • Blanking, blinking, and reverse fields • three ways to TAB • 16 Function keys do the work of 32 • Detachable keyboard.

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ATARI® 800™ PERSONAL COMPUTER SYSTEM

Comes with:
- Computer Console
- BASIC Language Cartridge
- Education System Master Cartridge
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- 800 Operator's Manual
- ATARI 410 Program Recorder
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- 10K ROM Operating System
- Power Supply
- TV Switch Box

SPECIFICATIONS:
High resolution color graphics
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Built-in RF modulator for channel 2/3 operation with standard TV set
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6502B Microprocessor
High speed serial I/O port

Atari 800 Computer System $995.95

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High resolution dot matrix impact printer
Uses standard 8½ inch roll paper and ribbon
40 characters per line
Speed: 40 characters per second
UL approved

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Uses standard 5¼ inch diskettes
88K bytes storage per diskette
Up to four disk drive units can operate with the system
Average data access time: 236 milliseconds
Power: AC adapter; UL approved

Atari 810 Disk Drive $699.95

Upgrade your computer with additional memory. (Note that the Atari 800 Computer comes with 8K of RAM memory and will accept up to 48K.)

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All orders must include 4% shipping and handling. Mass. residents add 5% sales tax. Mich. residents 4% for sales tax.

Phones open from 8:30 a.m. to 5:30 p.m. EST, Mon.-Fri. • P.O.'s accepted from D&B rated companies – shipment contingent upon receipt of signed purchase order • All prices are subject to change without notice • Most items in stock for immediate shipment – call for delivery quotation • In the Ann Arbor area? Our retail store is open 11:00 a.m. to 7:00 p.m. Tues.-Fri. 10:00 a.m. to 5:00 p.m. Saturdays (closed Sun. and Mon.)

IF NOT SATISFIED RETURN PURCHASE WITHIN 10 DAYS FOR A FULL REFUND.

✓ Reader Service—see page 257

Power Supplies! Power Supplies! Power Supplies! SOLID STATE!! (5)

We got 'em! Take your pick . . .

These units are ideal for micro computers. They have been removed from equipment, checked out and guaranteed.

1—5 volts @ 8 amps + 12 volts @ 2 amps + 6 volts @ 75 MA. Power supply has a 3-wire line cord and fused. Dimensions: 10½" × 5½" × 4½". Shipping weight: 16 lbs. ..... 37.50 ea. 2/70.00

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3— + 5 volts at 5 amps ± 12 volts at 500 ma. + 6 volts at 25 ms. (line cord included). ..... 32.95 ea. 2/60.00

4—Elexon, multi output. Input: 120/240 AC, ±10%, 47-63 hz; output: 1) 12V, 1.5A, DC, OVP; 2) 12V, 1.5A, D.C., OVP. New, in box with operating instructions. 31.50

5—Power Design, Model 1210, constant voltage, DC. P.S. input: 105-125 A.C., 55 to 440 hz. Output: 1-12 volts, 0-10 amps, DC. continuously adjustable output voltage and current limiting. 139.00

COMPUTER GRADE CAPACITORS . . .

18,000 mfd 10 VDC	1.25	11,000 mfd 25 VDC	1.50	4,000 mfd 75 VDC	1.75
4,400 mfd 20 VDC	1.00	35,000 mfd 35 VDC	3.50	1,000 mfd 100 VDC	1.00
46,000 mfd 20 VDC	2.50	10,000 mfd 50 VDC	2.50	6,800 mfd 100 VDC	3.50
3.000 mfd 25 VDC	1.00	22,000 mfd 60 VDC	3.75	4,700 mfd 150 VDC	3.75

WIRE WRAP BOARDS

These boards are pre-wired and removed from equipment. Easy to unwrap for setting up your own board, contains mostly 14-pin IC sockets with individual pin connections. Each board has VCC and ground planes.

Smaller board measures 6½" × 6" and has 40 to 50 sockets.
Larger board measures 13½" × 6" and has 75 to 100 sockets.



Reduced prices **$7.50 ea. 2/$14.00**
$12.50 ea. 2/$23.00

DIABLO System Disc Drive

SERIES 40, MODEL 43

100 tracks per inch, total capacity of 50 megabits, w/Model 429 power supply, sector counter, 24 sectors, 1 fixed disc, 1 removable disc, average access time 38 ms, PPM: 2600, dimensions: 10 5/16" high, fits in standard rack, equipped with full extension slides, excellent used condition. Shipped freight collect.



$2495

HEWLETT PACKARD model 200CD/rack mounted AUDIO OSCILLATOR freq:5hz to 600khz output: 160mw $165.00

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TRANSFORMERS

ISOLATION STEP-DOWN TYPE

Primary: 230/115V, 50/60 CPS, Secondary: 115 volts output 250 VA. **$13.95** EACH

ROTRON WHISPER FANS

Unused, Model Rotron MU 3A1, 230V, AC, 14 watts, 50/60 hz, guaranteed, 4½" × 4½" × 1½" **$8.95**

Clock Crystal Oscillators—TTL, Vectron, type CO-231T. Crystal freq. 4.9152 mhz. Input voltage 5 VDC ±. Output: Drives 10 TTL Loads Logic "0": 0.4V max., sink 16ma. Logic "1" 2.4V min source 2 ma. (above 50 mhz drives 2 Schottky TTL loads). Tuning adjust. with nominal range of ±30 ppm below 25 mhz and 15 ppm above 25 mhz. R.F.E. 1½" × 1½" × ½". $13.95

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FREQ: 15 TO 400 MHZ, VHF-UHF

Output: AM & FM: CW. FM deviation: ±1% to ±20% at any frequency. Crystal markers every 200Khz, 1mhz, 5mhz or ±10B. Frequency accuracy ±1%. Built-in oscilloscope for observing waveforms.

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Manufactured by I.T.T.

These units have rotary dials. Colors are: white, black, red, and green. They are packaged and have 6-foot cord and installation instructions. Used, but in good operating condition.

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* ONE SERIAL PORT USING AN 8251 WITH PROVISIONS FOR PARITY, STOP BIT AND CHARACTER LENGTH. BAUD RATES 110 TO 9600 BAUD. OUTPUTS RS232, TTL AND CURRENT LOOP.
* KANSAS CITY STANDARD CASSETTE INTERFACE, 300 BAUD FOR USE WITH THE SERIAL INTERFACE.
* STATUS MAY BE POLLING SOFTWARE OR VECTURED INTERRUPTS.

PCBD $31.95

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ARITHMETIC PROCESSOR FOR APPLE 7811A. Kit $350.00

APPLE ASYNCHRONOUS SERIAL INTERFACE 7710A. Kit $89.95

APPLE SYNCHRONOUS SERIAL INTERFACE 7712A. Kit $89.95

ALL OTHER CCS PRODUCTS AVAILABLE

SSM

PB-1 2708 & 2716 Programming Board with provisions for 4K or 8K EPROM. No external supplies required. Textool sockets. Kit.....$129.95

CB-1A 8080 Processor Board. 2K of PROM 256 BYTE RAM power on/rest Vector Jump Parallel port with status. Kit ....$129.95 PCBD $27.95

VB-3 80 x 55 VIDEO BOARD. Graphic included. 4 MHZ $379.95

IO-4 Two serial I/O ports with full handshaking 20/60 ma current loop: Two parallel I/O ports. Kit .....$130.00 PCBD $27.95

VB-1B 64 x 16 video board, upper lower case Greek composite and parallel video with software, S-100. Kit .....$125.00 PCBD $27.95

CB-2 Z80 CPU BOARD. Kit $185.95

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MEM-1A 8K x 8 fully buffered, S-100, uses 2102 type rams. PCBD $25.95

QM-12 MOTHER BOARD, 13 slot, terminated, S-100 board only $38.95

CPU-1 8080A Processor board S-100 with 8 level vector interrupt. PCBD $27.95

RTC-1 Realtime clock board. Two independent interrupts. Software programmable. PCBD..... $24.95

EPM-1 1702A 4K Eprom card. PCBD $25.95

EPM-2 2708/2716 16K/32K EPROM CARD. PCBD $25.95

QM-9 MOTHER BOARD. Short Version of QM-12. 9 Slots. PCBD $32.95

MEM-2 16K x 8 Fully Buffered 2114 Board. PCBD $27.95

PTB-1 POWER SUPPLY AND TERMINATOR BOARD. PCBD $27.95

IOB-1 SERIAL AND PARALLEL INTERFACE. 2 parallel, one serial and cassette. PCBD $27.95

2708.....$ 9.49 2114L 450 NSEC $5.99

2716.....$35.95 2114L 200 NSEC $6.99

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CPU-1 with MIKOS #2 8080A CPU .....$ 94.95

QM-12 with MIKOS #4 13 slot mother board .....$ 95.95

RTC-1 with MIKOS #5 real time clock.....$ 59.95

EMP-1 with MIKOS #10 4K 1702 less EPROMS .....$ 49.95

EPM-2 with MIKOS #11 16-32K EPROMS less EPROMS .....$ 59.95

QM-9 with MIKOS #12 9 slot mother board .....$ 89.95

FPB-1 with MIKOS #14 all parts for front panel $144.95

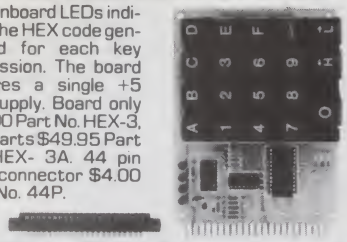
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Reader Service—see page 257

HEX ENCODED KEYBOARD

Four onboard LEDs indicate the HEX code generated for each key depression. The board requires a single +5 volt supply. Board only $15.00 Part No. HEX-3, with parts $49.95 Part No. HEX- 3A. 44 pin edge connector $4.00 Part No. 44P.



ASCII TO CORRESPONDENCE CODE CONVERTER

This bidirectional board is a direct replacement for the board inside the Trendata 1000 terminal. The on board connector provides RS-232 serial in and out. Sold only as an assembled and tested unit for $249.95. Part No. TA 1000C

ASCII KEYBOARD

53 Keys popular ASR-33 format • Rugged G-10 P.C. Board • Tri-mode MOS encoding • Two-Key Rollover • MOS/DTL/TTL Compatible • Upper Case lockout • Data and Strobe inversion option • Three User Definable Keys • Low contact bounce • Selectable Parity • Custom Keycaps • George Risk Model 753. Requires +5, -12 volts. $59.95 Kit.

T.V. INTERFACE



● Converts video to AM modulated RF, Channels 2 or 3. So powerful almost no tuning is required. On board regulated power supply makes this extremely stable. Rated very highly in Doctor Dobbs' Journal. Recommended by Apple ● Power required is 12 volts AC C.T., or +5 volts DC ● Board only $7.60 part No. 107, with parts $13.50 Part No. 107A

TAPE INTERFACE



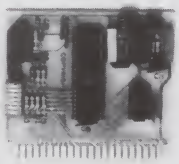
● Converts a low cost tape recorder to a digital recorder ● Works up to 1200 baud ● Digital in and out are TTL-serial ● Output of board connects to mic. in of recorder ● Earphone of recorder connects to input on board ● No coils ● Requires +5 volts, low power drain ● Board only $7.60 Part No. 111, with parts $29.95 Part No. 111A

T.V. TYPEWRITER



● Stand alone TVT ● 32 char/line, 16 lines, modifications for 64 char/line included ● Parallel ASCII (TTL) input ● Video output ● 1K on board memory ● Output for computer controlled curser ● Auto scroll ● Non-destructive curser ● Curser inputs: up, down, left, right, home, EOL, EOS ● Scroll up, down ● Requires +5 volts at 1.5 amps, and -12 volts at 30 mA ● All 7400, TTL chips ● Char. gen. 2513 ● Upper case only ● Board only $39.00 Part No. 106, with parts $145.00 Part No. 106A

UART & BAUD RATE GENERATOR



● Converts serial to parallel and parallel to serial ● Low cost on board baud rate generator ● Baud rates: 110, 150, 300, 600, 1200, and 2400 ● Low power drain +5 volts and -12 volts required ● TTL compatible ● All characters contain a start bit, 5 to 8 data bits, 1 or 2 stop bits, and either odd or even parity. ● All connections go to a 44 pin gold plated edge connector ● Board only $12.00 Part No. 101, with parts $35.00 Part No. 101A, 44 pin edge connector $4.00 Part No. 44P

ASCII KEYBOARD

TTL & DTL compatible • Full 67 key array • Full 128 character ASCII output • Positive logic with outputs resting low • Data Strobe • Five user-definable spare keys • Standard 22 pin dual card edge connector • Requires +5VDC, 325 mA. Assembled & Tested. Cherry Pro Part No. P70-05AB. $119.95.



SOROC IQ 120



Upper/lower case display • Numeric keypad & cursor keys • Protected fields, ½ intensity display • RS 232 interface & aux. port. IQ120—$799.95 • IQ140 Detachable keyboard—$1199.95

MODEM



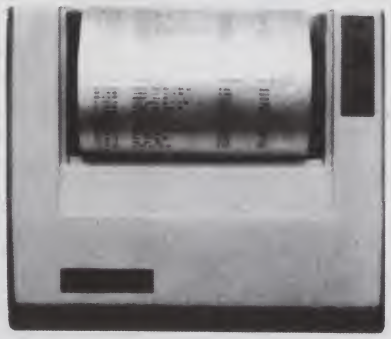
● Type 103 ● Full or half duplex ● Works up to 300 baud ● Originate or Answer ● Serial TTL input and output ● connect 8 Ω speaker and crystal mic. directly to board ● Requires +5 volts ● Board only $7.60 Part No. 109, with parts $29.95 Part No. 109A.

44 BUS MOTHER BOARD



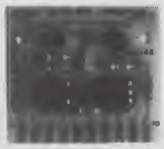
Has provisions for ten 44 pin (.156) connectors, spaced 3/4 of an inch apart. Pin 20 is connected to X, and 22 is connected to Z for power and ground All the other pins are connected in parallel. This board also has provisions for bypass capacitors. Board cost $15.00 Part No. 102. Connectors $3.00 each Part No. 44WP.

COMPRINT PRINTER



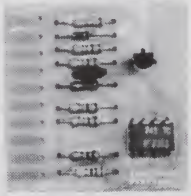
Printing Characteristics: 225 characters/second (170 lines/minute) throughput ● 9 horizontal x 12 vertical matrix ● 96 ASCII character set with upper and true lower case ● 80 characters/line ● 5.8 lines/inch
Buffer Memory: standard 256 bytes; ● optional; 2,048 bytes (buffer memory option designated as Model 912-2K), add $149.95.
Paper Requirements: electrosensitive type (aluminum coated) ● 8-1/2 inch width ● 3.7 inch max. (300 ft.) roll diameter.
Model 912-S Interfacing: serial interface RS232 and 20 mA current loop ● BAUD rates 110, 150, 300, 600, 1200, 2400 and 4800 are strap selectable.
Model 912-P Interfacing: parallel interface, IEEE-488 and 8 bit parallel (strobe/ acknowledge). Model 912-S, Part No. CPIA, 32118, $579.95. Model 912-P, Part No. CPIA, 32117, $559.95.

RS-232/20mA INTERFACE



This board has two passive, opto-isolated circuits. One converts RS-232 to 20mA, the other converts 20mA to RS-232. All connections go to a 10 pin edge connector. Requires +12 and -12 volts. Board only $9.95, part no. 7901, with parts $14.95 Part No. 7901A.

RS-32/TTL INTERFACE



● Converts TTL to RS-232, and converts RS-232 to TTL ● Two separate circuits ● Requires -12 and +12 volts ● All connections go to a 10 pin edge connector, kit $9.95 Part No. 232A 10 Pin edge connector $3.00 part No. 10P.

COMPUCOLOR II



With reg. keyboard
MOD3 8K $1595.95
MOD4 16K $1695.95
MOD 5 32K $1995.95
Now includes $250 more, worth of software and accessories with 101 key option add $134.95 with 117 key option add $179.95

DC POWER SUPPLY

● Board supplies a regulated +5 volts at 3 amps., +12, -12, and -5 volts at 1 amp. ● Power required is 8 volts AC at 3 amps., and 24 volts AC C.T. at 1.5 amps. ● Board only $12.50 Part No. 6085, with parts excluding transformers $42.50 Part No. 6085A



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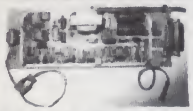
16K $975.95, Extra 16K E.S. RAM installed $74.95, extra 32K E.S. RAM installed $148.95.

APPLE II HOBBY/ PROTOTYPING CARD
Part No. 7907 $14.95

REAL TIME 100,000 DAY CLOCK

MT. HARDWARE Double the utility of your S-100 bus computer with a real-time clock that keeps time in 100μS increments for over 273 years. Program events for the entire period with real time interrupts...without derailing the system. Maintain a log of computer usage, time and date transaction printouts, call up lists...virtually any activity where time is a factor. On-board battery backup. MHPX004—$249.95

SUPER MODEM



Orignate, RS-232 and 20 mA compatable, Full duplex, and half duplex, direct connect or acoustic coupled, on board power supply, carrier detect light, DB25 plug , 300 BAUD, Type 103 compatable frequencies, Bare board Part No. 2000, $19,95, Kit Part No. 2000A, $99.95.

16K EPROM



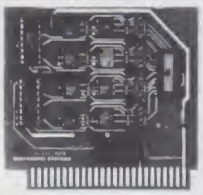
Uses 2708 EPROMS, memory speed selection provided, addressable anywhere in 65K of memory, can be shadowed in 4K increments. Board only $24.95 part no. 7902, with parts less EPROMs $49.95 part no. 7902A.

PET COMPUTER



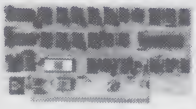
With 16K & monitor - $795. Dual Disk Drive - $1095

OPTO-ISOLATED PARALLEL INPUT BOARD FOR APPLE II



There are 8 inputs that can be driven from TTL logic or any 5 volt source. The circuit board can be plugged into any of the 8 sockets of your Apple II. It has a 16 pin socket for standard dip ribbon cable connection. Board only $15.00. Part No. 120, with parts $69.95. Part No. 120A.

VIDEO TERMINAL



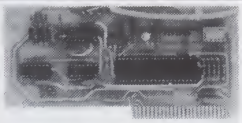
16 lines, 64 columns • Upper and lower case • 5x7 dot matrix • Serial RS-232 in and out with TTL parallel keyboard input • On board baud rate generator 75, 110, 150, 300, 600, & 1200 jumper selectable • Memory 1024 characters (7-21L02) • Video processor chip SFF96364 by Neculonic • Control characters (CR, LF, →, ←, ↑, ↓, non destructive cursor, CS, home, CL • White characters on black background or vice-versa • With the addition of a keyboard, video monitor or TV set with TV interface (part no. 107A) and power supply this is a complete stand alone terminal • also S-100 compatible • requires +16, & −16 VDC at 100mA, and 8VDC at 1A. Part No. 1000A $199.95 kit.

PARALLEL TRIAC OUTPUT BOARD FOR APPLE II



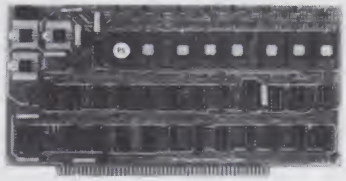
This board has 8 triacs capable of switching 110 volt 6 amp loads (660 watts per channel) or a total of 5280 watts. Board only $15.00 Part No. 210, with parts $119.95 Part No. 210A.

APPLE II* SERIAL I/O INTERFACE



Baud rate is continuously adjustable from 0 to 30,000 • Plugs into any peripheral connector • Low current drain. RS-232 input and output • On board switch selectable 5 to 8 data bits, 1 or 2 stop bits, and parity or no parity either odd or even • Jumper selectable address • SOFTWARE • Input and Output routine from monitor or BASIC to teletype or other serial printer • Program for using an Apple II for a video or an intelligent terminal. Also can output in correspondence code to interface with some selectrics. • Also watches DTR • Board only $15.00 Part No. 2, with parts $42.00 Part No. 2A, assembled $62.00 Part No. 2C

8K EPROM PICEON



• Programs 2708's address relocation of each 4K of memory to any 4K boundary • Power on jump and reset jump option for "turnkey" systems and computers without a front panel • Program saver software in 1 2708 EPROM $25. Bare board $35 including custom coil, board with parts but no EPROMS $139, with 4 EPROMS $179, with 8 EPROMS $219.

WAMECO PRODUCTS

With ELECTRONIC SYSTEMS parts

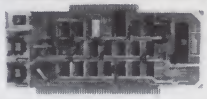
FDC-1 FLOPPY CONTROLLER BOARD will drive shugart, pertek, remex 5" & 8" drives up to 8 drives, on board PROM with power boot up, will operate with CPM (not included). PCBD $42.95
FPB-1 Front Panel. (Finally) IMSAI size hex displays. Byte or instruction single step. PCBD $42.95
MEM-1A 8Kx8 fully buffered, S-100, uses 2102 type RAMS. PCBD ..... $24.95, $168 Kit
QMB-12 MOTHER BOARD, 13 slot, terminated, S-100 board only ..... $34.95 $89.95 Kit
CPU-1 8080A Processor board S-100 with 8 level vector interrupt PCBD .. $25.95 $89.95 Kit
RTC-1 Realtime clock board. Two independent interrupts. Software programmable. PCBD ..... $25.95, $60.95 Kit
EPM-1 1702A 4K EPROM card PCBD ..... $25.95 $49.95 with parts less EPROMS
EPM-2 2708/2716 16K/32K EPROM card PCBD ..... $24.95 $49.95 with parts less EPROMS
QMB-9 MOTHER BOARD. Short Version of QMB-12. 9 Slots PCBD ..... $30.95 $67.95 Kit
MEM-2 16Kx8 Fully Buffered 2114 Board PCBD ..... $25.95, $269.95 Kit

D.C. HAYES MICROMODEM



Fully S-100 bus compatible including 16-bit machines and 4 MHz processors. • Two software selectable Baud rates—300 Baud and a jumper selectable speed from 45 to 300 Baud. (110 standard). Supports originate and answer modes. • Direct-connect Microcoupler. This FCC-registered device provides direct access into your local telephone system, with none of the losses or distortions associated with acoustic couplers and without a telephone company supplied data access arrangement. • Auto-Answer/Auto-Call. The MICROMODEM 100 can automatically answer the phone and receive input; it can also dial a number automatically. • Automatic Reset and Disconnect. • Software compatible with the D.C. Hayes Associates 80-103A Data Communications Adapter. Micromodem-DCHA32625—$379.95

TIDMA

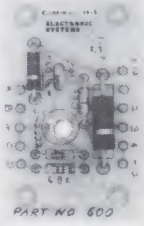


Tape Interface Direct Memory Access • Record and play programs without bootstrap loader (no prom) has FSK encoder/decoder for direct connections to low cost recorder at 1200 baud rate, and direct connections for inputs and outputs to a digital recorder at any baud rate • S-100 bus compatible • Board only $35.00 Part No. 112, with parts $110.00 Part No. 112A.

SYSTEM MONITOR

8080, 8085, or Z-80 System monitor for use with the TIDMA board. There is no need for the front panel. Complete with documentation $12.95.

RS-232/TTY INTERFACE



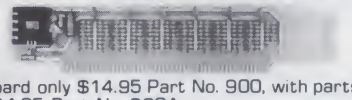
This board has two active circuits, one converts RS-232 to 20 mA, the other converts 20 mA to RS-232. Requires +12 and -12 volts. $9.95 Part No. 600A Kit.

SERIAL I/O



Four Serial I/O RS-232 ports. S-100 Bus, Software or jumper selectable baud rate (110, 300, 600, 1200, 2400, 4800, 9600, 19.2K), on board Xtal baud rate generator, Addressing, switch selectable, Panty or no panty (odd or even) switch selectable, 1 or 2 stop bits, 5 to 8 bits/character. Board only $29.95, Part No. 7908. With parts (kit) $199.95, Part No. 7908A.

S-100 BUS ACTIVE TERMINATOR



Board only $14.95 Part No. 900, with parts $24.95 Part No. 900A

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Reader Service—see page 257

MICROBYTE SYSTEM — 100



$499.95

System 100 includes
- Microbyte Enclosure
- Microbyte 20 slot mother board with active termination
- IEEE S-100 compatible
- 25 amp heavy duty power supply
- Front console voltage monitors
- Custom air filter
- Corcom AC line filter
- 115/230v 50-60 Hz operation
- Hi CFM cooling fan

LP-2 Economy Logic Probe

For many applications, the LP-2 offers basic performance at a substantially lower price. Similar to the LP-1, but for slower circuits and without the Memory feature. Detects pulse events as 300 nsec and 1.5 MHz. High 300,000 Ohm input impedance guards against circuit loading.

LP-3 High Speed Memory Probe

Our highest performance logic probe, the LP-3 detects pulses as narrow as 8 nsec (typical, tested at 10 nsec) pulse/resolution and up to over 50 MHz. This is unquestionably the probe to use with today's higher speed logic systems. High input impedance. Other features similar to the LP-1. Includes LOA-S ground wire (p-15)



$25.95

$65.95

MSM5832 MICROPROCESSOR REAL-TIME CLOCK/CALENDAR

GENERAL DESCRIPTION

The MSM5832 is a monolithic, metal-gate CMOS integrated circuit that functions as a real time clock, calendar for use in bus-oriented microprocessor applications. The on-chip 32.768 Hz crystal controlled oscillator time base is counted down to provide addressable 4-bit I/O data of SECONDS, MINUTES, HOURS, DAY-OF-WEEK, DATE, MONTH, and YEAR. Data access is controlled by 4-bit address, chip select, read, write and hold inputs. Other functions include 12H/24H format selection, leap year identification and manual + 30 second correction.

The MSM5832 normally operates from a 5 volt ± 5% supply. Battery back-up operation down to 2.2 volts allows continuation of time keeping when main power is off. One test input facilitates rapid testing of the time keeping operations. The MSM5832 is offered in an 18-lead dual-in-line plastic (RS suffix) package.

FEATURES

- Microprocessor bus-oriented

TIME	MONTH	DATE	YEAR	DAY OF WEEK
23 59 59	12	31	99	7

- 4-BIT DATA BUS
- 4-BIT ADDRESS
- Read, Write, Hold, Chip select inputs
- Interrupt signal outputs—1024, 1, 1/60, 1/3600 Hz
- leap year identification and manual + 30 second correction
- 32.768 KHz crystal controlled operation
- Leap year register bit
- 12 or 24 hour format
- + 30 second error correction
- Single 5 volt power supply
- Back-up battery operation to VCC 2.2 V
- Low Power Dissipation
  90 μw Max. at VCC 3 V
  2.5 mw Max. at VCC 5 V
- High Density 300 mil 18-Pin Package

$745

APPLE EXPANSION KIT

16K

Memory add-on with instructions

$54.95

Model 7811A for your APPLE

Arithmetic Processor

$369.00

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Allows continuous connection of any three of the Apple game port options.



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LOWEST IN PRICE—HIGHEST IN PERFORMANCE

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base2, inc.



EPROM ERASER BY SPECTOLINE

UP TO 6 EPROMS IN 19 MINUTES

6000 HOUR BULB LIFE ★

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- S-100 compatable
- IEEE standard
- Connectors have bifurcated, gold plated contacts
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- Fully assembled and factory tested

$179.95

Model 2520A Extender/Terminator

ACTIVE AND/OR DYNAMIC OPERATION

POWER LINES ALL FUSED

CCS $37.00



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Apple Disk	3.75
Apple Keyboard	8.75
TRS-80 Keyboard	7.75
TRS-80 Recorder	3.75
TRS-80 Single Disk	3.75
TRS-80 Double Disk	6.75
TRS-80 Model Keyboard	7.75
Pet Disk	7.75
Pet Terminal/Comp	15.75
Northstar Computer	11.75
Soroc Terminal	10.75



$17.95

LOGIC PROBE KIT

S-100 16K ADD-ON BARE BOARD

WITH DOCUMENTATION AND DETAILED INSTRUCTION BOOK. $28.95

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2708	1kx8 EPRM (450ns)	7.55
2716	1kx16 EPRM (450ns)	24.95
8038	VCO Waveform Gen.	2.55
4116	16kx1 Dyn RAM (300ns)	6.00
4116	16kx1 DYN RAM (200ns)	7.00
2114L	1kx4 Static RAM (450ns)	4.75
2114L	1kx4 Static RAM (250ns)	5.50
8212	I/O Port	3.25
8216	Bus Driver	1.99

74LS240	2.25
74LS241	2.25
74LS243	2.25
74LS244	2.25
74LS373	2.55
74LS374	2.55
74S138	3.95



APPLE II Computer with full 48K of memory!

$1099.00

Plexiglass cover as shown

$24.95

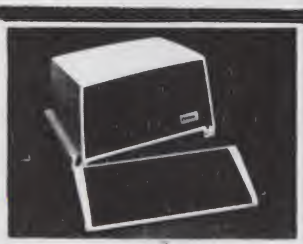
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IQ140 $1199.00

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S-100 MEMORY ADD-ON

** FULLY STATIC OPERATION
** USES 2114 TYPE STATIC RAMSMS
** +8 VDC INPUT AT LESS THAN 2 AMPS
** BANK SELECT AVAILABLE BY BANK PORT AND BANK BYTE
** PHANTOM LINE CAPABILITY
** ADDRESSABLE IN 4K BLOCKS IN 4K INCREMENTS
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** SOLDER MASK ON BOTH SIDES OF BOARD

ASSEMBLED & TESTED $269.00

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TRS 80

16K Memory Add-On

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with jumpers and instructions

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Starting at just $129.95 for a Level "A" operating system, you can now build the exact computer you want. Explorer/85 can be your beginner's system, OEM controller, or IBM-formatted 8" disk small business system...yet you're never forced to spend a penny for a component or feature you don't want and you can expand in small, affordable steps!

Now, for just $129.95, you can own the first level of a fully expandable computer with professional capabilities—a computer which features the advanced Intel 8085 cpu, *thereby giving you immediate access to all software and development tools that exist for both the 8085 and its 8080A predecessor (they are 100% software compatible)*—a computer which features onboard S-100 bus expansion—plus instant conversion to mass storage disk memory with either 5-1/4" diskettes or standard IBM-formatted 8" disks.

For just $129.95 (plus the cost of a power supply, keyboard/terminal and RF modulator, if you don't have them already), Explorer/85 lets you begin *computing* on a significant level... *applying* the principles discussed in leading computer magazines...*developing* "state of the art" computer solutions for both the industrial and leisure environment.

Level "A" Specifications

Explorer/85's Level "A" system features the advanced Intel 8085 cpu, an 8355 ROM with 2k deluxe monitor/operating system, and an 8155 ROM-I/O—all on a single motherboard with room for RAM/ROM/PROM/EPROM and S-100 expansion, *plus* generous prototyping space.

(Level "A" makes a perfect OEM controller for industrial applications and is available in a special Hex Version which can be programmed using the Netronics Hex Keypad/Display.)



Level "A" at $129.95 is a complete operating system, perfect for beginners, hobbiests, or industrial controller use.

PC Board: glass epoxy, plated through holes with solder mask • **I/O:** provisions for 25-pin (DB25) connector for terminal serial I/O, which can also support a paper tape reader ...provision for 24-pin DIP socket for hex keyboard/display...cassette tape recorder input...cassette tape recorder output...cassette tape control output...speaker output... LED output indicator on SOD (serial output) line...printer interface (less drivers)...total of four 8-bit plus one 6-bit I/O ports • **Crystal Frequency:** 6.144 MHz • **Control Switches:** reset and user (RST 7.5) interrupt...additional provisions for RST 5.5, 6.5 and TRAP interrupts onboard • **Counter/Timer:** programmable, 14-bit binary • **System RAM:** 256 bytes located at F8Ø0, ideal for smaller systems and for use as an isolated stack area in expanded systems...RAM expandable to 64k via S-100 bus or 4K on motherboard.

System Monitor (Terminal Version): 2k bytes of deluxe system monitor ROM located at F*ØØØ* leaving *ØØØØ* free for user RAM/ROM. Features include tape load with labeling ...tape dump with labeling...examine/change contents of memory ...insert data...warm start...examine and change all registers...single step with register display at each break point, a debugging/training feature...go to execution address... move blocks of memory from one location to another...fill blocks of memory with a constant...display blocks of memory ...automatic baud rate selection...variable display line length control (1-255 characters/line)...channelized I/O monitor routine with 8-bit parallel output for high speed printer... serial console in and console out channel so that monitor can communicate with I/O ports.

System Monitor (Hex Version): Tape load with labeling... tape dump with labeling...examine/change contents of memory...insert data...warm start...examine and change all



registers...single step with register display at each break point ...go to execution address. Level "A" in the *Hex Version* makes a perfect controller for industrial applications and can be programmed using the Netronics Hex Keypad/Display.



Hex Keypad/Display.

Hex Keypad/Display Specifications

Calculator type keypad with 24 system defined and 16 user defined keys. 6 digit calculator type display which displays full address plus data as well as register and status information.

Level "B" Specifications

Level"B" provides the S-100 signals plus buffers/drivers to support up to six S-100 bus boards and includes: address decoding for onboard 4k RAM expansion select-able in 4k blocks...address decoding for onboard 8k EPROM expansion selectable in 8k blocks...address and data bus drivers for onboard expansion...wait state generator (jumper selectable), to allow the use of slower memories...two separate 5 volt regulators.



Explorer/85 with Level "C" card cage.

Level "C" Specifications

Level "C" expands Explorer's motherboard with a card cage, allowing you to plug up to six S-100 cards directly into the motherboard. Both cage and cards are neatly contained inside Explorer's deluxe steel cabinet. Level "C" includes a sheet metal superstructure, a 5-card gold plated S-100 extension PC board which plugs into the motherboard. Just add required number of S-100 connectors

Level "D" Specifications

Level "D" provides 4k or RAM, power supply regulation, filtering decoupling components and sockets to expand your Explorer/85 memory to 4k (plus the original 256 bytes located in the 8155A). The static RAM can be located anywhere from *ØØØØ* to EFFF in 4k blocks.

Level "E" Specifications

Level "E" adds sockets for 8k of EPROM to use the popular Intel 2716 or the TI 2516. It includes all sockets, power supply regulator, heat sink, filtering and decoupling components. Sockets may also be used for soon to be available RAM IC's (allowing for up to 12k of onboard RAM).

Order A Coordinated Explorer/85 Applications Pak!

Experimenter's Pak (SAVE $12.50)—Buy Level "A" and Hex Keypad/Display for **$199.90** and get FREE Intel 8085 user's manual plus FREE postage & handling!

Student Pak (SAVE $24.45)—Buy Level "A," ASCII Keyboard/Computer Terminal, and Power Supply for **$319.85** and get FREE RF Modulator plus FREE Intel 8085 user's manual plus FREE postage & handling!

Engineering Pak (SAVE $41.00)—Buy Levels "A," "B," "C," "D," and "E" with Power Supply, ASCII Keyboard/Computer Terminal, and six S-100 Bus Connectors for **$514.75** and get 10 FREE computer grade cassette tapes plus FREE 8085 user's manual plus FREE postage & handling!

Business Pak (SAVE $89.95)—Buy Explorer/85 Levels "A," "B," and "C" (with cabinet), Power Supply, ASCII Keyboard/Computer Terminal (with cabinet), 16k RAM, 12" Video Monitor, North Star 5-1/4" Disk Drive (includes North Star BASIC) with power supply and cabinet, all for just **$1599.40** and get 10 FREE 5-1/4" minidiskettes ($49.95 value) plus FREE 8085 user's manual plus FREE postage & handling!

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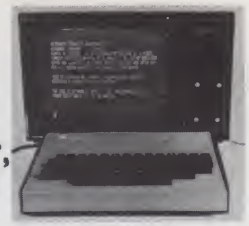
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Please send the items checked below—

- ☐ **Explorer/85 Level "A" Kit** (ASCII Version), **$129.95** plus $3 p&h.
- ☐ **Explorer/85 Level "A" Kit** (Hex Version), **$129.95** plus $3 p&h.
- ☐ **8k Microsoft BASIC** on cassette tape, **$64.95** postpaid.
- ☐ **8k Microsoft BASIC in ROM Kit** (requires Levels "B," "D," and "E"), **$99.95** plus $2 p&h.
- ☐ **Level "B" (S-100) Kit, $49.95** plus $2 p&h.
- ☐ **Level "C" (S-100 6-card expander) Kit, $39.95** plus $2 p&h.
- ☐ **Level "D" (4k RAM) Kit, $69.95** plus $2 p&h.
- ☐ **Level "E" (EPROM/ROM) Kit, $5.95** plus 50¢ p&h.
- ☐ **Deluxe Steel Cabinet** for Explorer/85, **$49.95** plus $3 p&h.
- ☐ **ASCII Keyboard/Computer Terminal Kit** (features a full 128 character set, upper & lower case, full cursor control, 75 ohm video output convertible to baudot output, selectable baud rate, RS232-C or 20 ma. I/O, 32 or 64 character by 16 line formats, and can be used with either a CRT monitor or a TV set (if you have an RF modulator), **$149.95** plus $2.50 p&h.
- ☐ **Hex Keypad/Display Kit, $69.95** plus $2 p&h.
- ☐ **Deluxe Steel Cabinet** for ASCII Keyboard/Terminal, **$19.95** plus $2.50 p&h.
- ☐ **Power Supply Kit** (±8V @ 5 amps) in deluxe steel cabinet, **$39.95** plus $2 p&h.
- ☐ **Gold Plated S-100 Bus Connectors, $4.85** each, postpaid.
- ☐ **RF Modulator Kit** (allows you to use your TV set as a monitor), **$8.95** postpaid.
- ☐ **16k RAM Kit** (S-100 Board expands to 64k), **$199.95** plus $2 p&h.
- ☐ **32k RAM Kit, $329.95** plus $2 p&h.
- ☐ **48K RAM Kit, $459.95** plus $2 p&h.
- ☐ **64k RAM Kit, $589.95** plus $2 p&h.
- ☐ **16k RAM Expansion Kit** (to expand any of the above up to 64k), **$139.95** plus $2 p&h each.
- ☐ **Intel 8085 cpu User's Manual, $7.50** postpaid.
- ☐ **Special Computer Grade Cassette Tapes, $1.90** each or **3 for $5,** postpaid.
- ☐ **12" Video Monitor** (10 MHz bandwidth), **$139.95** plus $5 p&h.
- ☐ **North Star Double Density Floppy Disk Kit** (One Drive) for Explorer/85 (includes 3 drive S-100 controller, DOS, and extended BASIC with personalized disk operating system—just plug it in and you're up and running!), **$699.95** plus $5 p&h.
- ☐ **Power Supply Kit** for North Star Disk Drive, **$39.95** plus $2 p&h.
- ☐ **Deluxe Case** for North Star Disk Drive, **$39.95** plus $2 p&h.
- ☐ **Experimenter's Pak** (see above), **$199.90** postpaid.
- ☐ **Student Pak** (see above), **$319.85** postpaid.
- ☐ **Engineering Pak** (see above), **$514.75** postpaid.
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Reader Service—see page 257



By Netronics

ASCII/BAUDOT, STAND ALONE

Computer Terminal

COMPLETE FOR ONLY... $149.95

The Netronics ASCII/BAUDOT Computer Terminal Kit is a microprocessor-controlled, stand alone keyboard/terminal requring no computer memory or software. It allows the use of either a 64 or 32 character by 16 line professional display format with selectable baud rate, RS232-C or 20 ma. output, full cursor control and 75 ohm composite video output.

The keyboard follows the standard typewriter configuration and generates the entire 128 character ASCII upper/lower case set with 96 printable characters. Features include onboard regulators, selectable parity, shift lock key, alpha lock jumper, a drive capability of one TTY load, and the ability to mate directly with almost any computer, including the new Explorer/85 and ELF products by Netronics.

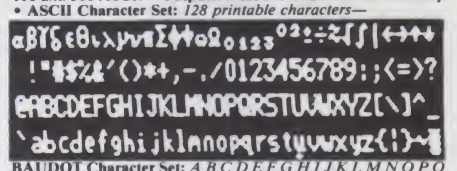
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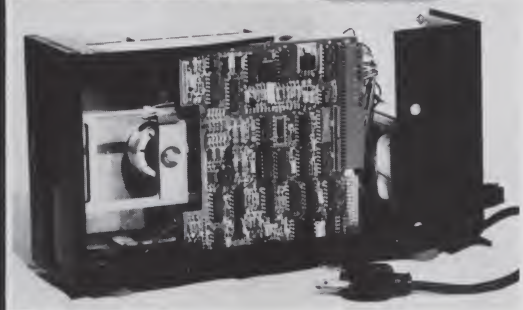
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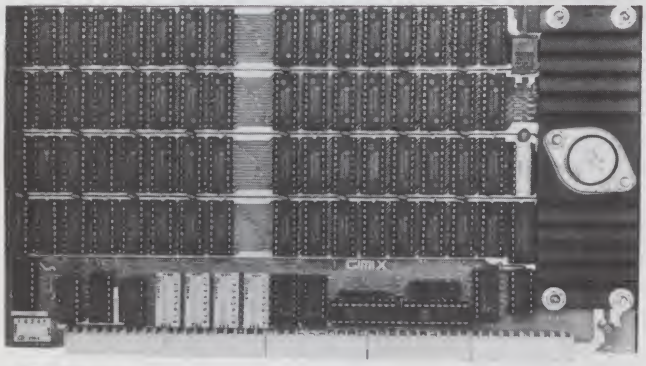


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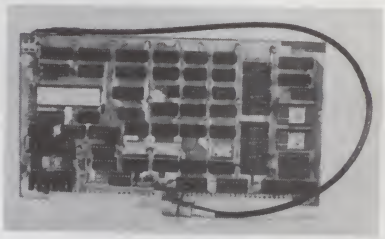
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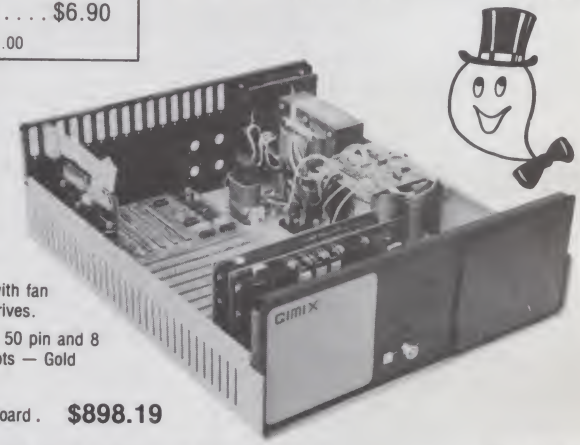
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- ☐ 2. 18-22
- ☐ 3. 23-40
- ☐ 4. 41-60
- ☐ 5. over 60

II. What are your primary applications for microcomputing (check only two)?
- ☐ A. Business
- ☐ B. Games
- ☐ C. Home
- ☐ D. Education
- ☐ E. Scientific
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- ☐ G. Music

III. What other magazines do you subscribe to (check all that apply)?
- ☐ 1. 80 Microcomputing
- ☐ 2. 73 Magazine
- ☐ 3. Byte
- ☐ 4. Creative Computing
- ☐ 5. Interface Age
- ☐ 6. Personal Computing

IV. How much have you spent on hardware?
- ☐ A. less than $500
- ☐ B. $500-1,000
- ☐ C. $1,000-2,000
- ☐ D. $2,000-4,000
- ☐ E. $4,000-6,000
- ☐ F. more than $6,000

V. How much have you spent on software?
- ☐ 1. less than $100
- ☐ 2. $100-250
- ☐ 3. $250-500
- ☐ 4. $500-1,000
- ☐ 5. more than $1,000

VI. What do you plan to buy during the next year (check all that apply)?
- ☐ A. Complete system
- ☐ B. Disk system
- ☐ C. Impact printer
- ☐ D. Dot matrix printer

VII. What system do you own and use most (check only one)?
- ☐ 1. Radio Shack
- ☐ 2. Commodore
- ☐ 3. Apple
- ☐ 4. Atari
- ☐ 5. Heath
- ☐ 6. SWTP
- ☐ 7. Exidy
- ☐ 8. North Star
- ☐ 9. Compucolor
- ☐ 10. other

VIII. How many disk drives do you own?
- ☐ A. none
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101	106	111	116	121	226	231	236	241	246	351	356	361	366	371	476	481	486	491	496
102	107	112	117	122	227	232	237	242	247	352	357	362	367	372	477	482	487	492	497
103	108	113	118	123	228	233	238	243	248	353	358	363	368	373	478	483	488	493	498
104	109	114	119	124	229	234	239	244	249	354	359	364	369	374	479	484	489	494	499
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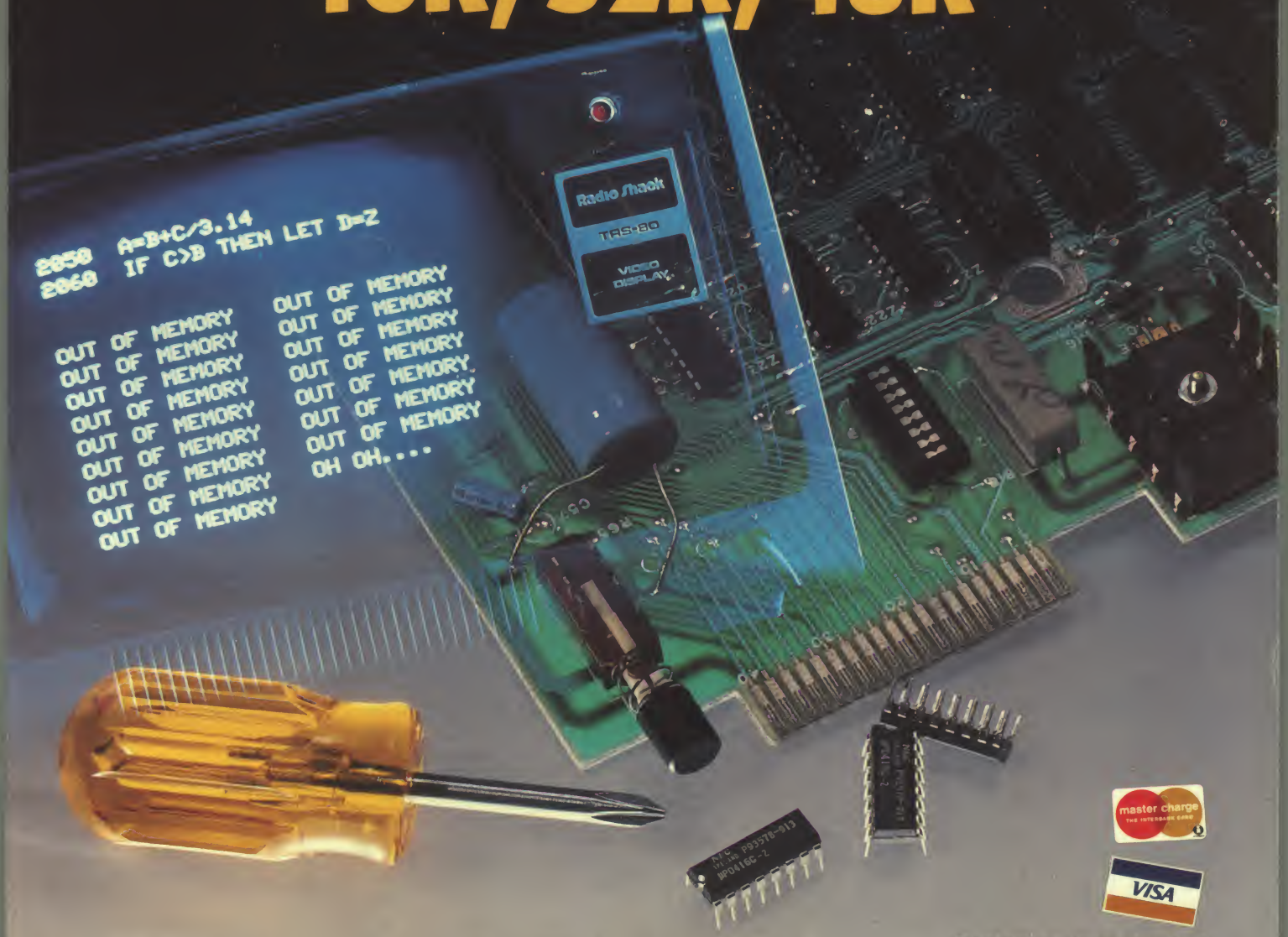
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